

Country Profile

Pacific Island Countries

November 2006

The Australian Centre for International Agricultural Research (ACIAR) operates as part of Australia's international development cooperation program, with a mission to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia. ACIAR commissions collaborative research between Australian and developing country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

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Preface

The ACIAR Country Profiles are designed to give a snapshot of the collaborative research being carried out between Australia and our various partner countries. This publication contains short summaries of bilateral and multilateral projects with Pacific island countries that were active at 30 June 2006. At that time there were 27 active bilateral projects and three active multilateral projects, the latter being led by an international agricultural research centre. There were another 16 bilateral and one multilateral projects under development, many of which are expected to start in 2006–07 financial year.

This publication also sets out the key outputs and outcomes from five bilateral and one multilateral projects completed since 30 June 2006.

In addition to these project summaries, the publication includes an extract from ACIAR's 2005–06 Annual Report covering the Pacific island countries, our near-term program as outlined in the 2006-07 Annual Operational Plan, and a record of the most recent consultations held between ACIAR and Pacific island countries on the medium-term priorities for the joint program.

ACIAR updates this profile each year and distributes it to key stakeholders in the Pacific and Australia.

We hope you find the publication useful as a record of the progress and achievements of ACIAR's collaborative research and development program with Pacific island countries. For information on ACIAR's overall program, we invite you to visit our website at www.aciar.gov.au.



Peter Core
Director

November 2006

Pacific Islands Report 2005–06

(extract from ACIAR Annual Report 2005–06)

Active projects in 2005–06	36
AOP budgeted expenditure in 2005–06	\$2,518,000
Actual bilateral country expenditure in 2005–06	\$2,158,938
Bilateral country expenditure in 2004–05	\$2,105,536
Bilateral country expenditure in 2003–04	\$1,721,121

Key performance indicators	Performance 2005–6
<ul style="list-style-type: none"> Integration of at least two ACIAR project activities with farmer participatory research–extension activities supported under the SPC-Development of Sustainable Agriculture in the Pacific (DSAP) program 	Linkages formed with active projects SFS/2003/047 (<i>plant protection, Solomon Islands</i>) and HORT/2004/063 (<i>Brassica IPM, Fiji and Samoa</i>) and in two Solomon Islands pipeline projects (CP 2005/134 and HORT/2005/077). ACIAR participated with SPC–DSAP and others to support the Pacific Regional Seminar on Participatory Agricultural Research and Extension.
<ul style="list-style-type: none"> Research leading to short-term improvement of export crops emphasised in at least two projects 	HORT/2003/046 (<i>Tonga squash</i>) and HORT/2004/049 (<i>Fiji ginger</i>), SFS/2001/023 (<i>Samoa horticulture industry development</i>) designed/commenced, with emphasis on quality improvement of product for export.
<ul style="list-style-type: none"> Costs and benefits of alternative management approaches for migratory tuna stocks identified 	Bio-economic model progressed under SFS/2001/036 (<i>Maximising the economic benefits to Pacific Island Nations from management of migratory tuna stocks</i>) with technical issues updated under the harvest function. Recommendations on balance of harvesting effects on tuna stocks re-examined.
<ul style="list-style-type: none"> Chemical and biocontrol options for taro beetle successfully trialled 	A combination of chemical and biological controls investigated to develop an integrated control measure in project CP/2000/044.
<ul style="list-style-type: none"> Policy and technical environments for the growth of aquaculture significantly improved in at least two countries 	Fiji has benefited from participation in a sub-regional seaweed marketing study. Solomon Islands, Kiribati, Vanuatu and Fiji benefited through the development of cost-effective tilapia diets derived from local ingredients. A Pearl Industry Management Plan was finalised in Kiribati to guide the development of a profitable and sustainable industry.
<ul style="list-style-type: none"> Major forest health threats to Pacific plantations documented 	An output of project FST/2001/045 was a major report <i>Forest pests in the South Pacific Region: a review of the major causal agents of tree disorders</i> , which documented the major threats to Pacific plantations. A further ACIAR project to establish forest pest detection systems in South Pacific countries has commenced.
<ul style="list-style-type: none"> 40% of new projects designed to have significant farmer or policy-maker impacts within 5 years of completion 	Two of the four projects designed in 2005–06 structured to have significant impacts anticipated within five years of finish date—FIS/2005/108 (<i>freshwater prawn aquaculture</i>) and HORT/2004/063 (<i>Brassica pests and production</i>).

Position

ACIAR's program with the Pacific has grown in recent years, in line with Australian official development assistance priorities. Some of the factors constraining development of Pacific Island countries are small size, physical isolation, limited natural resource base and inadequate communications infrastructure. As such Pacific Islands are facing serious challenges—including widespread unemployment—that are fuelling poverty and social instability. Combined with these are deteriorating health problems, environmental challenges and rapid urbanisation. Many economies have a culture of aid or remittance dependence, with limited opportunities for commodity exports and a lack of competitiveness and market advantage for their agricultural products in an increasingly global trade environment.

Demographic factors include high population growth rates in some countries, and there are difficulties with retention of well-trained personnel. Within the main themes of the Australian Pacific Regional Aid Strategy (2004–09) and the recently released Pacific 2020 Report, both of which are designed to promote stronger broad-based growth, ACIAR's Pacific program aims particularly to provide income generation and employment opportunities and promote sustainable management of the environment. This entails securing the production of major crops and fishery products as well as encouraging potential new niche farm, fisheries and forestry products. Foreign-vessel access fees to fishing grounds within their respective exclusive economic zones provide substantial income for many countries.

ACIAR encourages the involvement of international centres in the region and supports some regional collaborations.

Achievements

The Pacific Island countries involved in ACIAR research include Fiji, Solomon Islands, Vanuatu, Kiribati, Tonga and Samoa. In many instances the Pacific countries share problems in common and research results can be adapted and applied in countries throughout the region.

ACIAR-funded research supports Australian expertise to help Pacific nations address a wide range of pests and diseases. This is exemplified in taro, after a significant outbreak of **taro leaf blight** devastated the crop in Samoa in the 1990s. Efforts were undertaken to set up a bank of blight-resistant taro varieties that could be grown instead of the susceptible varieties, but these were hampered by the presence of viruses known to be lethal to taro. A multinational research effort has made substantial progress in characterising viruses and developing reliable detection tests. The work was also an opportunity to map the entire genetic diversity of taro from Fiji, Samoa, Tonga, Niue, Palau and the Cook Islands, along with large collections from PNG, Solomon Islands, Vanuatu and New Caledonia. This knowledge bank, together with efforts in association with SPC to develop a broader diagnostic tool for the full spectrum of taro diseases, is now enabling the transportation of high-yielding disease-free lines of taro around the region.

The **taro beetle** is another significant pest that has grown worse with the intensification of agriculture due to rising human populations. The project work to combat the beetle entailed a combination of insecticide application and biological control. In December 2005 the project team initiated some participatory farmer field trials and on-farm demonstrations. Special efforts are under way to ensure that the insecticides employed leave no undesirable residues in the plants or the environment.

In Fiji **ginger** is another significant crop under threat, in this case from soil-borne diseases, and production is declining and affecting rhizomes—the horizontal stems producing roots. Production systems rely on these for new plants. Evidence suggests that increasing the microbial diversity found in root zones of plants can ameliorate soil-borne pathogen damage, and a new project is using this knowledge to test and develop recommendations for appropriate control strategies.

In Tonga, efforts are in progress to test a range of 'soft' fungicides to **combat powdery mildew**. Work in Australia developed a powdery mildew screening procedure, using a scanning program to assess percentage severity of the disease. Six cultivars of squash screened for resistance to powdery mildew were found susceptible, with no evidence of partial resistance. This led to glasshouse trials of several fungicide treatments, and from these the most effective fungicides were selected for further testing in a field trial in late 2005.

Production of **brassica species**—mainly head cabbage, Chinese cabbage and watercress—has increased in Fiji and Samoa, but along with increased production has come an upsurge in the incidence of the pest **diamondback moth**. Integrated pest management (IPM) approaches that limit insecticide use while maintaining control of the moth are in use elsewhere, and research is now adapting successful IPM programs developed in Southeast Asia to the conditions found in Fiji and Samoa.

Yams, a food of great traditional and ceremonial importance in Pacific island life, are being slowly replaced by cheaper foods. An ACIAR project aims to lift production and help return this vegetable to its rightful place by identifying and ameliorating some nutrient deficiencies. In Vanuatu fertiliser trials produced very little response until studies of the feeder roots revealed they had spread horizontally up to five metres and to depths around 40 cm. This led to trials that placed the fertiliser in a ring some distance from the plant, making it more available for plant growth than previously when it had been placed under the seed tuber.

A survey involving young professionals from the University of the South Pacific gathered information about **levels of contamination by animal manure** around several villages in four collaborating countries (Fiji, Tonga, Tuvalu and Kiribati). They determined current manure management practices and cultural attitudes towards manure. The data affirmed that livestock numbers are increasing and that the pig in particular tends to be a significant contributor to water pollution in many communities. One village relocated the access point for the supply of drinking water further upstream. As well, around 20 farmers in Fiji have changed their free-range extensive system, where pigs roam free in the village and on nearby land, to a semi-intensive production system with pigs housed at all times.

The **spread of zoonoses** (diseases capable of transmission from livestock to humans) and pollution implications of increasing livestock numbers in close proximity to human populations have been the subjects of a project involving Fiji, Kiribati and PNG. Researchers focused on three diseases—*Leptospirosis*, *Trichinellosis* and *Angiostrongylosis*. The scientists developed a reliable serological diagnosis for the first two diseases, along with a specific test for pathogenic *Leptospira* species. The project has now been extended to initiate community education about disease transmission and how to reduce its incidence, to investigate the potential of vaccination to control bovine *leptospirosis* in commercial and smallholder cattle herds in PNG, and to undertake a survey in Kiribati for *Trichinella*, *Leptospira* and some enteric protozoa in livestock.

Also in Kiribati, surveys of **black-lip pearl oysters** found that very few occur naturally, but the country now has a highly productive hatchery—achieving 50 per cent survival, well above the 20 per cent considered exceptional elsewhere. Some of the oysters have produced a salmon pink to bronze nacre that has real market attraction. Kiribati now has plenty of young black-lip oysters and is moving into production of full-sized spherical pearls.

Assessing **groundwater resources** on Kiribati has brought together a combination of local and overseas expert knowledge on groundwater and water supply. The result is a model of the hydrology and salinity dynamics—AtollScape. A role-playing game, AtollGame has helped local officials explore different scenarios to develop equitable water management options. The study found that a 30 per cent increase in sustainable freshwater extraction was possible for the capital, South Tarawa—a significant increase in a country with less than 30 litres/capita/day of reticulated fresh water. But when allowances for El Niño-related droughts were factored in it became evident that additional groundwater sources would be needed for South Tarawa by 2010. The government has now initiated investigations for these additional sources.

In Vanuatu **native sandalwood** is harvested for valuable aromatic oils, but natural resources are declining. A project is providing vital genetic information to ensure that replanting can be undertaken with fast-growing trees that produce excellent wood and high quality oil. Island surveys have identified high-performing oil-yielding varieties in many locations, and the project is now developing participatory tree domestication strategies to prepare the best performers for growing in plantations. Sandalwood is known as a hemi-parasite, and must grow in association with other tree species. Thus the research also involves establishing associations between the sandalwood and compatible species. Complementary research is under way in northern Australia.

In Samoa, a project is helping to boost **horticulture enterprises**. In interviews, the main issues raised by taro growers were identification of new varieties and pest and disease management without the excessive use of chemical pesticides. Papaya growers wanted more information on growing, husbandry, harvesting and grading, and would like help to identify export markets and price, while agro-processors were concerned about issues of packaging and labelling. Roadside vendors were most concerned about overnight storage of produce and maintaining its quality and shelf-life. The project team is now mapping the 'information supply chain' of each target group—to identify key information sources, providers and repositories and to investigate importance of the relationships in the dissemination and use of information.

Efforts are also in place to help **smallholder farmers in Solomon Islands**. Pests and diseases threaten many of the country's major food root crops, and a project seeks to identify these pests and diseases and to promote sustainable cropping with fewer pesticides. Another project aims to increase the number of eggs produced by village hens, by helping village poultry farmers identify more nutritious poultry feed sources in their own gardens. As part of the project, a poultry production research facility is being established to test and identify suitable local feed resources.

The **impacts of trade liberalisation in Fiji's agriculture sector**, which is important both economically and as a food producer, are not yet fully understood. The country's ecosystem is fragile, easily converted to agricultural uses and vulnerable to climate change. A project has as its primary objective to evaluate the environmental effects of agricultural trade liberalisation, together with the agricultural production and trade effects of environmental change, in order to devise supportive policies to enhance the process of sustainable development in Fiji. So far, researchers have completed the update of the Fiji Input-Output database, developed an environmental module and collected data for the environmental analysis aspect of the project.

Pacific Island Countries Plan 2006–07

(extract from ACIAR Annual Operational Plan 2006–07)

Population ¹	2.0 million	Bilateral actual 2004–05	\$2.05m
Population 2015/2050 ²	2.2/2.7 million	Bilateral forecast 2005–06	\$2.52m
Active bilateral projects	20	Bilateral budget 2006–07	\$2.44m
Active multilateral projects	2	Bilateral + Multilateral budget 2006–07	\$2.85m

GNI per capita ³			
Fiji	AUD 3,638	Samoa	AUD 2,466
Solomon Islands	AUD 925	Tonga	AUD 2,297
Vanuatu	AUD 1,819	Kiribati	AUD 1,357

Medium-term strategy

ACIAR's strategy for the Pacific recognises that the agricultural economy, both for basic food security and cash incomes, impacts on the livelihoods of the vast majority of Pacific Island peoples. Agriculture has the potential, above all other economic sectors, to broadly raise incomes and economic growth.

To achieve this growth potential, ACIAR's program will focus on securing the production of major existing crops and fishery products as well as potential new niche farm, fisheries and forestry products. The forestry and fisheries sectors represent a major economic resource and a significant source of both foreign exchange and domestic revenue. An emphasis will be on enhanced productivity and marketing of primary commodities and consequent improvements in competitiveness on both the domestic and export markets where possible. Specific subject areas cover quarantine and biosecurity, product quality and nutrition, trade and market access, and supply chain development.

The application of research and technologies to smallholder systems to secure community benefits will be maintained given its overriding importance in Pacific nation economies. This approach will be combined with capacity building initiatives to achieve improved participation and partnerships to support adoption of research by the final users. This can be achieved more readily through strategic partnerships with regional organisations and other donors. Partnerships with NGOs, private industry and civil society will be maintained and enhanced. Partnerships will include both the identification of research opportunities and the execution and implementation of projects. The medium term strategy will also address many of the challenges confronting agriculture, fisheries and forestry in Pacific Island countries identified through the Government's 'Pacific 2020' papers⁴.

¹ Source: United Nations Population Division, 2005, *World Population Prospects: The 2004 Revision*, http://www.un.org/esa/population/publications/WPP2004/World_Population_2004_chart.pdf, composed of Fiji (0.9 million), Solomon Islands (0.5 million), Vanuatu (0.2 million), Samoa (0.2 million), Tonga (0.1 million) and Kiribati (0.1 million).

² Source: United Nations Population Division, 2005, *World Population Prospects: The 2004 Revision*, http://www.un.org/esa/population/publications/WPP2004/World_Population_2004_chart.pdf, composed of Fiji (0.9 / 0.9 million), Solomon Islands (0.6 / 0.9 million), Vanuatu (0.3 / 0.4 million), Samoa (0.2 / 0.2 million), Tonga (0.1 / 0.08 million) and Kiribati (0.1 / 0.2 million).

³ Source: Source: Commonwealth of Australia, *Australia's Overseas Aid Program 2006-07*, Statement by Minister Alexander Downer, May 2006.

⁴ Source: Pacific 2020 Report, May 2006.

Key performance indicators (2006–07)

- Agricultural systems policy options to secure trade liberalisation opportunities (including domestic adjustments) developed for at least two countries
- Design and commence two new forestry projects with linkages to value addition through processing
- Delivery of improved nutritional information for consumers and extension providers
- Progress the sustainable management of Pacific fisheries through completion of at least two studies on stock replenishment and re-establishment
- Demonstrated capacity building achievements through effective partnerships and dissemination plans on all projects
- Develop farmer group testing of at least three integrated crop management packages

Position

ACIAR's program with the Pacific Islands will continue to develop in line with broader Australian foreign policy and development assistance priorities. The long term development challenges of the region depend heavily on the potential of agriculture, fisheries and forestry for economic growth. The sustainable management of these resources while also raising producer incomes remains a central focus of ACIAR's research agenda. In this context, sound locally owned policies and practices will be further developed. The development of an agricultural enabling environment including training, extension, land tenure and suitable production systems for primary industry sectors that are often under-performing is an ongoing objective.

Agriculture and fishing comprise a majority of the livelihoods of Pacific Island countries. Many smallholders live in isolated rural communities dependent on household food production and intermittent crop, fish and small livestock sales. Improving and transforming these systems into an income-generating activity through improved productivity and marketing will enhance self-reliance and reduce poverty over time.

Commodity exports include sugar, fruit and vegetables, vanilla, pepper, kava, hardwood logs and timber, softwood timber, fish and other marine products; substantial income is also gained from foreign vessel access fees to fishing grounds within each country's exclusive economic zone.

Many of the limiting factors for sectoral growth and development of Pacific Island countries will continue over the medium and even long term. These include small size, physical isolation, limited natural resource base, inadequate communications infrastructure, aid/remittance dependence of many economies, limited opportunities, human development constraints, lack of competitiveness in a global trading environment, high population growth and the challenges of environmental degradation and resource depletion.

One of the four key themes of the Australian Pacific Regional Aid Strategy (2004–09) is to promote stronger broad-based growth, including 'strengthening the enabling environment for public sector development ... improving economic competitiveness ... with a focus on providing income generation and employment opportunities and sustainable management of the environment'⁵. ACIAR's Pacific program aims particularly to underpin this theme of the Strategy.

Participation in regional or multi-country programs and projects that address common problems will help to overcome constraints including lack of capacity of many countries to engage in collaborative activities. Projects must also be designed to meet the risks associated with institutional and staff resource limitations. ACIAR also specifically encourages the involvement of International Agricultural Research Centres in the region.

⁵ Source: Commonwealth Government: Pacific Regional Aid Strategy 2004-2009, AusAID 2004.

Relationship to the AusAID regional strategy

AusAID's Pacific regional aid strategy 2004-2009 states that 'Australia will continue to work cooperatively with Pacific Regional Organisations to support their improved effectiveness and impact in the region....'. It identifies 'stability as the fundamental underpinning factor of development, by supporting a strong policy and economic environment and strengthening the drivers of economic growth'. There are four regional themes, including stronger broad-based growth (improving economic competitiveness as well as expanding the productive sectors that drive broad-based growth, with a focus on providing income generation and employment opportunities and sustainable management of the environment); more effective, accountable and democratic government; improved law and justice and security; and, enhanced service delivery. There is also a commitment that an increased proportion of assistance will be focused on the countries of Melanesia.

ACIAR's Pacific program assists this strategy, particularly the first thematic area of broad-based growth. It recognises that agriculture and fisheries (along with tourism and remittances) are the main sources of income for many Pacific countries, but that there is a need to secure the production of major existing crops and fishery products as well as to explore development of potential new niche farm, fisheries and forestry products. The program has a strong emphasis on marketing to support the twin roles of agriculture for income generation as well as food security. Work on agricultural policies and quarantine assists with the first two objectives. The ACIAR program also has a strong emphasis on working with Pacific Regional Organisations (such as SPC and USP) to improve their effectiveness in agriculture, fisheries and forestry. Over the last three years an increased percentage of the ACIAR budget is being invested in Melanesian countries.

Indicative priorities and current project portfolio

ACIAR most recently held formal program consultations on priorities with representatives of the six bilateral partner countries and key regional organisations in Suva in December 2003. The outcomes of this consultation are available at www.aciar.gov.au under 'Partner country priorities/South Pacific region'. ACIAR managers also meet regularly with the Secretariat of the Pacific Community (SPC), the South Pacific Applied Geoscience Commission (SOPAC) and the University of the South Pacific (USP). ACIAR also attends the regular regional priority-setting meetings of Pacific government agriculture, forestry and fisheries agencies.

In 2006–07 research priorities are categorised within four themes:

- Improving incomes through more productive farming systems
- Sustainable management of forestry and fishery resources
- Biosecurity and pest and disease management
- Farming systems economics and marketing

Priority areas for future collaboration include:

Subprogram 1: Improving incomes through more productive farming systems

- Integration of existing knowledge into information packages for bananas and taro
- Facilitating adoption of earlier research on pest, weed and disease management
- New opportunities for inland aquaculture, including the domestication of promising indigenous species and integration into existing farming systems
- Utilisation of locally available materials to develop cost-effective feed formulations for pigs, poultry and aquaculture species
- Value-adding processing of forest products

Subprogram 2: Sustainable management of forestry and fishery resources

- Stock status assessment and planning for the sustained use of vulnerable inshore fisheries, with an emphasis on increased community-level management and co-management
- Domestication of multipurpose trees for forestry and agroforestry, including selection of suitable germplasm and silvicultural management
- Sustainable management (and protection from pests and diseases) of high-value plantations and native forests.

- Watershed protection functions and groundwater management in forestry systems
- Land and water resource use planning for optimal development of agriculture, forestry and fisheries enterprises
- Resource valuations and economic analyses of smallholder and commercial fisheries.

Subprogram 3: Biosecurity and pest and disease management

- Identification of quarantine and pest risk issues for crop germplasm requiring exchange between countries
- Development and adoption of integrated crop management packages (including pest, weed and disease control)
- Environmentally appropriate pest and disease management to maintain the export squash industry in Tonga
- Regional studies of import risks associated with the movement of live aquatic organisms and the definition of appropriate quarantine strategies

Subprogram 4: Farming systems economics and marketing

- Economic and marketing analyses of aquaculture commodities to inform production decision-making and to identify opportunities for regional cooperation in marketing and processing
- Improved agricultural statistics to develop indicators that measure smallholder contribution to national economies
- Marketing research to help producers and industry identify market opportunities for agricultural commodities
- Economic analysis of current and new farming practices, including alternatives to slash-and-burn agriculture and organic farming
- Economic analysis of returns and certification issues of current and potential crops or commodities
- Analysis of the economic tradeoffs incurred in moving from access-fee arrangements for Distant Water Fishing Nation vessels to domestic allocation of tuna harvests and onshore processing/transshipment requirements

While the bulk of ACIAR's investment will be in the form of collaborative research projects, development and extension projects, ACIAR will consider a greater number of small initiatives. These may include support of consultant visits to address small but urgent problems, and follow on from earlier ACIAR-funded projects.

Projects will also endeavour to have a substantial training component, and short-term and postgraduate training opportunities will receive special attention. Training priorities, in addition to those offered within projects and through postgraduate degrees, include experimental design and analysis, research management and evaluation, writing for research and extension audiences, the research–extension interface (including farmer participatory processes) and information and communication technologies. In all Pacific partners, but especially in Vanuatu, Solomon Islands and Kiribati, there is a critical need for additional agricultural researchers with postgraduate training.

Country-specific issues

Although several of the challenges for agriculture, forestry and fisheries are common to most Pacific nations, and much of the ACIAR program in the Pacific is delivered through regional organisations, we recognise that different nations have different priorities and requirements. ACIAR will continue to support a limited number of single country-specific projects on major issues. A statement on strategy and research opportunities for each of the six Pacific countries through which ACIAR operates bilaterally is provided below.

Fiji

Fiji's poverty level is comparatively low, though rural–urban income inequality is an increasing problem. There is a good natural resource base for agriculture, forestry and fisheries. After a period of ACIAR project emphasis on crop and livestock production, crop protection and agricultural economics foci began more recently. There has also been strong ongoing cooperation in fisheries. Fiji also hosts the main campus of the University of the South Pacific and the bases of the SPC Land Resources Division, the Pacific Forum Secretariat, and several relevant NGOs.

Sugar production is decreasing, and the development of alternative land uses for agriculture within a sustainable land management framework is a national imperative. A high priority in ACIAR's program in Fiji is economic and technical research aimed at developing alternative crops to sugar and in understanding the impact of specific policy changes on Fiji's food production sector, in coordination with other government and donor initiatives. Development of promising horticultural crops and accompanying postharvest technologies and marketing options are being explored.

Opportunities for research to contribute to improved livelihoods in fisheries include genetic selection of freshwater finfish and giant prawns; aquatic health including quarantine and import risk assessment; restocking as a tool to rehabilitate sea cucumber fisheries; and improved feed formulations for finfish and shrimp. More research may be needed on marketing of fisheries products, including seaweed. Some options for forestry cooperation include timber utilisation, value-adding to mahogany and native species, plantation management and health, and increasing the potential of indigenous forestry species.

Solomon Islands

The recent civil conflict caused stagnation or collapse in the production and export of many commodities. Fish, timber, copra, palm oil and cocoa were previously substantial exports, along with minerals such as gold. Most Solomon Islanders live in isolated rural communities dependent on subsistence agriculture and intermittent crop and small livestock sales.

ACIAR has a significant number of completed projects in the Solomon Islands, covering culture of a range of fish species, marine protected areas, stock assessment and fisheries management policy; farming systems economics; production and diseases of root crops; insect pests; biological control of pests; and forest tree nutrition. ACIAR's Solomon Islands program has had a strong fisheries emphasis, including economic and technical research to support the development of sustainable livelihood opportunities based on the culture of coral reef animals. ACIAR has a long-term commitment to cooperation with Solomon Islands, with this effort strongly focused on activities that will quickly contribute to enhanced smallholder income generation.

The loss of field station and laboratory infrastructure in the national agricultural research system means that we will collaborate in on-farm research and recognise that NGOs play an important role in agricultural service delivery. To this end we will encourage partnerships between national and provincial technical services and key rural NGOs in our projects. On-farm adaptive work will be a more feasible option under the present conditions.

Income generation initiatives, particularly in rural areas, remain important in the broader scheme of economic and social recovery in the Solomon Islands, and much of this necessarily needs to be in agriculture, forestry and fisheries. Immediate assistance can also include small, short-term technical interventions in areas where ACIAR projects have developed significant expertise elsewhere in the region. In addition, ACIAR will explore opportunities for specific linkages with AusAID's Transitional Support for Agriculture Program and subsequent initiatives as they are operationalised, and will interact with the World Bank and European Union in their preparation of an Agriculture and Rural Development Strategy for the Solomon Islands.

Vanuatu

Vanuatu's agriculture sector (along with tourism) remains the main focus of the country's development strategy. The main activities relate to coconut, cattle, cocoa, and timber production, with traditional food production for subsistence and local markets. Smallholders also cultivate peanuts, potatoes, vanilla and pepper. Although Vanuatu is an agricultural exporter, the majority of the population is in the subsistence or informal sector.

ACIAR's past program in Vanuatu has emphasised fisheries, crop sciences and forestry. The major partner for bilateral cooperation in Vanuatu is the Ministry of Agriculture, Quarantine, Forestry, and Fisheries (MAQFF), although some strong farmers' associations exist, and linkages with the French Agricultural Research Centre for International Development (CIRAD) and the private sector also provide opportunities.

With horticultural crops, market analysis of crop commodities for identification of niche markets that Vanuatu can fill is required. Crop protection and postharvest technology research to underpin development of horticultural export markets, and assistance with work on efficacy of fruit fly baits and on management of fruit piercing moth, may also be required. We will ensure that earlier ACIAR support for research on root crops in the region such as taro, yam and sweet potato is extended, through production of field guides and other extension material.

Targeted research to underpin village-level fisheries (including aquaculture) as well as commercial fisheries is also required. Livestock research may be more important in Vanuatu than elsewhere in the Pacific Islands. Forest covers almost 40 per cent of the total land area of Vanuatu, and policy and technical interventions for sustainable management of plantations and development of new species of commercial value for both plantations and smallholders are important. In forestry, assistance is needed in relation to assessing commercial prospects for native species, including sandalwood and *Canarium*, and controlling the *Merremia* vine.

Samoa

Samoa has recently had comparatively strong economic growth across a range of sectors, including agriculture. Samoa has reasonable research capacity in agriculture, forestry and fisheries. The Ministry of Agriculture, Forestry, Fisheries and Meteorology (MAFFM) has several research stations and experimental farms. Samoa is also the agriculture base of the University of the South Pacific, the Food and Agriculture Organisation of the United Nations (FAO) Subregional Program and the South Pacific Regional Environmental Program (SPREP).

There has been a strong emphasis in the ACIAR program on insect pest management (fruit flies, fruit piercing moth, whitefly and aphids), virus indexing of taro as well as biological control of pests and weeds. Some projects on forest nutrition and health and fisheries have been carried out.

There is expertise in Samoa in germplasm selection of root crops and fruits and in use of tissue culture propagation. Research opportunities include those that underpin the development of exports of high-value horticultural products. This may require postharvest research to improve shelf life and transport to underpin fruit exports and simple processing/value addition of fruit tree and root crops. Research to assist improvements in niche marketing of commodities, potentially including organic produce, is of importance. This may include identification of alternative extension and information transfer technologies.

In forestry, research opportunities may exist in the areas of: policy incentives for establishment of woodlots; nursery management techniques; forest weeds, pests and diseases; and better utilisation of timbers. Increasing wood yields from sawmilling is a high priority as there is currently significant wastage. Options for cooperation with the proposed AusAID Samoan Community Forestry Project will be investigated. In fisheries, opportunities may include research on community-based approaches to the management of reef fisheries and technical interventions to underpin the development of village aquaculture industries.

Tonga

Factors affecting agricultural development include geographical isolation, fluctuations in export markets for Tongan produce, a limited natural resources base and governance structures. Tonga has high natural disaster susceptibility, and limited income-generating opportunities for outer islanders.

ACIAR's past program in Tonga has included many disciplines. For crop-related research, future support is likely to be in the area of marketing and postharvest quality improvement. Farming systems is a current emphasis. Development of markets is an ongoing challenge, although Tonga has developed a successful export trade in pumpkin squashes over recent years. Research on environmentally appropriate pest and disease management to maintain this industry remains a priority. Other areas of research emphasis in Tonga include productivity of root crops and vegetables, development of new crops such as coffee and spices, and development of capacity in postharvest technology. Crop protection including fruit fly management is still important, as is better soil and water management for agriculture and other uses. Development of agroforestry-based farming systems, including tree legumes and fruit trees, is a priority, and is the main focus in forestry, since plantation resources are modest.

Tuna is the main fishery export from Tonga, and together with snapper and aquarium fish is a major export income source. Research will continue into the development of aquaculture systems for commercially important reef species (e.g. hatchery production and growout of blacklip pearl oyster, hatchery production of winged oyster). There may be opportunities for research to build on a current AusAID fisheries support project, in areas such as small-scale fisheries, for example of sea cucumber and community-based fisheries management.

Kiribati

Kiribati is one of the poorest Pacific countries, having few land-based natural resources, but has jurisdiction over one of the largest Exclusive Economic Zones in the world. The small land area leads to a high and increasing population density on some of its atolls and an accompanying risk of environmental damage from agriculture and other human activities.

The large marine area in the country makes fisheries important for export and subsistence and a logical priority for cooperation. Issues such as tuna resource rents are critical for Kiribati, as is the identification of new village-level mariculture opportunities. There are only limited opportunities in other agricultural sectors, although further exploration of these areas will be pursued.

ACIAR's program in Kiribati has had a strong fisheries emphasis, most notable being the long-standing, ongoing effort directed at the development of a sustainable profitable pearl culture industry. Availability and quality of water for agriculture and domestic purposes is a critical issue. Research to reduce the dependence on imported food crops and on the conservation and use of traditional food crops will link to opportunistic involvement in applied research on crop pests and diseases, including taro beetle, breadfruit fungal rot and biocontrol of spiralling white fly of pawpaw. In livestock, improved local feeds for pigs and chickens are important for food security. Limited opportunities for recruitment of skilled human resources in Kiribati constrain opportunities for collaboration.

Key program managers

Dr Simon Hearn, Smallholder Farming Systems
Mr Les Baxter, Horticulture
Mr Barney Smith, Fisheries
Dr Russell Haines, Forestry

Country Manager (for Solomon Islands)

Dr Jacqui Wright, ACIAR Country Manager, PNG and Solomon Islands

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at 30 June 2006

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ADP/2002/105: Economic and market analysis of the live reef fish food trade in Asia-Pacific

Overseas Collaborating Countries	Fiji, Indonesia
Commissioned Organisation	Australian National University, Australia
Project Leader	Dr Brian Johnston Phone: 02 6125 6555 Fax: 02 6125 0767 Email: njvj@iimetro.com.au
Collaborating Institutions	University of Western Australia, Australia James Cook University, Australia WorldFish Center, Malaysia Secretariat of the Pacific Community, New Caledonia Bogor Agricultural University, Indonesia Center for Marine and Fisheries Product Processing and Social Economics, Indonesia
Project Budget	\$413,070
Project Duration	01/07/2004 to 31/03/2007 (Project extended from 01/01/2007 to 31/03/2007)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

The fish markets of Hong Kong and southern China place a price premium on live fish. This trade is now worth an estimated \$US350 million a year. Fish are in demand for a number of factors—type, colour, taste and rarity. With population and economic growth continuing in southern China and Hong Kong and demand for live fish spreading beyond these markets it is anticipated that demand will rise substantially.

For many coastal communities the potentially lucrative returns from tapping into these markets have not been matched by the realities. A number of developing countries—Indonesia, Papua New Guinea, Vietnam, Fiji and other Pacific Islands—are involved in the trade. For smallholder suppliers prices received for fish are usually low, reflecting the risk carried by those moving live fish from these areas to Hong Kong and China.

These low prices often result in overfishing to ensure greater returns. This threatens the sustainability of wild fisheries particularly where destructive practices are used. Another factor contributing to overfishing is a lack of knowledge of what fish species are desired by consumers. Knowing consumer preferences would allow more targeted fishing helping to alleviate stresses on wild fisheries through the development of sustainable management plans. It would also provide a focal point for aquaculture and mariculture enterprises and research to enhance productivity in these. Policy options to support the trade, including improving existing market supply chains, would also be possible. This project aims to enhance the sustainable economic development of the live reef food fish trade, through economic analysis of policy options for improved market performance.

Project progress

Year 2 (01/07/2005–30/06/2006)

Further substantial progress has been made on the project in the second 12 months. Key tasks completed include the publication of the proceedings of the first workshop which was held in Noumea, New Caledonia, 2-5 March 2005 (Johnston and Yeeting 2006). The workshop brought key researchers from the Asia-Pacific together for the first time to present the project to the Pacific Island countries involved in the trade. The workshop was successful in gaining their participation, including sharing of information among fishery managers and discussion of the potential usefulness of the modelling approaches being developed for the project. The first workshop also secured the ongoing participation of Indonesian fishery researchers.

The World Fish Centre (WFC) hosted a second workshop in Penang in March 2006. This provided the opportunity for researchers to present the major findings of their research for peer group review and to identify critical gaps in the research to date. The workshop covered five key areas:

- demand for live reef food fish
- developments in aquaculture
- analysis of the market chain
- regulation and management of the trade.

The participants at the second workshop agreed that the final stages of the project needed to focus on developing projections on further development of the LRFF trade, taking into account likely constraints on growth in the wild-caught sector which in many cases was already fully or over-exploited. In contrast, scope for expansion exists in the aquaculture sector of the LRFF trade, particularly as the technology of hatchery production of higher value species becomes more widely adopted. The aquaculture sector's dependence on juvenile fingerlings or young fish caught from the wild is also likely to be highly constrained due to reduced stocks of wild fish.

The model developed by the WorldFish Center has considerable potential to provide projections of supply and demand of LRFF from the major Asian countries already participating in the trade or developing major aquaculture capacity, such as China. It was agreed the model be extended to include all major Asian producers (Indonesia, Malaysia, Philippines, Thailand), China and 'Other' (which includes Australia and Pacific Island countries). There is a need to include both the wild capture and aquaculture sectors in each country and two categories of production, low priced species and high priced species. Demand would be modelled for Hong Kong and China. The market chain model also has considerable scope for further development, to include case studies of Asian and Pacific Island country fisheries and to include risk analyses. The information collected on the Indonesian fishery would provide a strong basis for a case-study, for example.

A key challenge for the future is to identify management arrangements that would effectively constrain fishing effort in many wild-caught fisheries and stamp out unsustainable practices that damage coral reefs, such as cyanide and use of explosives. The team will focus on these issues in the next stage of the project, to identify potential benefits and costs of improved management arrangements for the wild-caught fisheries across Asia and the Pacific. The potential for aquaculture to meet the rising demand for live reef fish as incomes grow across Asia and China is promising, but there are many issues warranting ongoing research.

This project is integrated with the ACIAR marine finfish aquaculture project co-ordinated by Dr Rimmer. Key issues for further R&D focus on improving the long-term sustainability of aquaculture to support the LRFF trade as well as other markets. These include improving the quantity and quality of seedstock supply from hatcheries, developing sustainable grow-out feeds, documenting and promoting best management practices and addressing market issues. The growing affluence of China is a key demand issue to be studied, as are the current stated consumer preferences for wild-caught over aquaculture product. Consumers also seem to have a growing awareness of the negative impacts of both capture fisheries and aquaculture, and demand is increasing for sustainably-produced products. Improving the sustainability of the LRFF trade through both capture fisheries and aquaculture continues to challenge fishers, traders, merchants and governments.

A number of follow-up actions have arisen from the workshop. The WorldFish Center is being contracted to extend the Live Reef Fish model to include China and Thailand as supplying countries, to include two broad categories of LRFF—higher and lower value species—and to allow welfare effects to be captured in the model output. The market chain model will be further developed to include risk analysis and to develop two possible case studies—one for a Pacific country and one for Indonesia. The demand analysis is to continue, to incorporate later data as these become available.

AH/2001/054: The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific

Overseas Collaborating Countries	Fiji, Kiribati, Papua New Guinea, Tonga
Commissioned Organisation	Murdoch University, Division of Veterinary and Biomedical Sciences, Australia
Project Leader	Dr Simon Reid Phone: 08 9360 7423 Fax: 08 9310 4144 Email: s.reid@murdoch.edu.au
Collaborating Institutions	National Agriculture Quarantine and Inspection Authority, Papua New Guinea Secretariat of the Pacific Community, Fiji University of Melbourne, Australia Children's Hospital, Westmead, Australia Department of Agriculture, Fisheries and Forestry, Australia WHO/FAO/OIE Collaborating Centre for Reference & Research on Leptospirosis, Australia
Project Budget	\$555,579
Project Duration	01/01/2002 to 30/06/2007 (Project extended from 01/01/2006 to 30/06/2007)
ACIAR Research Program Manager	Dr Peter Rolfe

Project background and objectives

Most countries and territories in the South Pacific are experiencing a growing demand for animal products, as human populations increase and expectations rise for higher living standards. Greater intensification of animal production in areas with limited land resources has increased the possibility of human–animal contact, and thus the risk of zoonotic disease. Trichinellosis, leptospirosis and angiostrongylosis are the diseases of most concern in the region. Leptospirosis infection causes production loss in livestock and is a serious public health issue, especially for owners of livestock and workers in the processing industry. *Angiostrongylus cantonensis* infection is an unquantified threat to livestock health and is emerging as a serious public health problem. *Trichinella* infection in pigs is a barrier to livestock trade and could result in a significant loss to producers. If this organism entered Australia, it could cause severe economic losses to the Australian pork industry.

Zoonotic diseases (diseases transmitted from animals to humans) are thought to be increasing in the South Pacific as livestock production intensifies. The aim of this project is to determine the extent of the problem posed by zoonotic diseases, and to develop control strategies to reduce their impact.

Project progress

Year 4 (01/01/2005–31/12/2005)

The majority of project activities are due to begin in 2006. There has been limited progress towards Objective 1 mainly because of delays in the finalisation of project documents for this extension. Preliminary discussions with cattle producers in the Markham Valley have been conducted and their cooperation achieved. The first survey is planned for May 2006.

Research activity to perform a cross-sectional survey of domestic pigs in PNG to prove freedom from *Trichinella* infection will commence in 2006. In 2005 a total of 327 crocodiles were screened for the presence of infection with *Trichinella* using the digest method. A total of 44 crocodiles were shown to be infected with *Trichinella* larvae, of which 27 came from Kikori, 12 from other locations and five were born on the farm. Larvae from the crocodiles from Ambunti (Sepik) were analysed at the International Trichinella Reference Centre, Rome and found to be genetically identical to larvae isolated crocodiles from Kikori. These data suggest that Kikori is the only source of infected crocodiles at Mainland Holdings. In addition, meat from three wild pigs from Ambunti was also negative for *Trichinella* infection.

ASEM/2004/011: Evaluating domestic tuna fisheries projects

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	University of Queensland, School of Economics, Australia
Project Leader	Professor Harry Campbell Phone: 07 3365 6570 Fax: 07 3365 7299 Email: h.campbell@economics.uq.edu.au
Collaborating Institutions	National Fisheries Authority, Papua New Guinea Forum Fisheries Agency, Solomon Islands
Project Budget	\$331,435
Project Duration	01/04/2005 to 31/03/2008
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

Access fees paid to Papua New Guinea (PNG) from other distant water fishing nations grant these nations a right to fish in PNG's exclusive economic zone. Fees from the exploitation of these waters account for around 2 per cent of PNG Government revenue. Recently, however, domestic fishing interests have begun to exploit PNG's tuna fisheries as a basis for income, food security and employment. These fisheries are currently being fished at the maximum level of sustainability; increasing catches will create pressure on tuna stocks that may be unsustainable. If the tuna fisheries are to remain sustainable the line between domestic and distant water fishing fleets must be redrawn.

The National Fishery Authority is responsible for managing the tuna fisheries and their sustainability. But will domestic activities bring net benefits to the PNG economy as they slowly replace distant water fishing nations' access fees? The PNG Government has adopted a policy to support the gradual domestication of the tuna industry in the hope of generating a wider range of returns. Building a framework, beginning with an existing model, in which to assess benefits from domestication is needed.

The project will support this by increasing the capacity of NFA, and other agencies, to perform independent economic analysis of proposed domestic tuna fisheries projects. This will be achieved by:

- modifying an existing evaluation framework and apply the framework to measure the private and social net benefits of a locally-based tuna operation in PNG, and
- generalising the framework to be relevant for analysis of policy decisions regarding domestication of tuna and other industries.

Project progress

Year 1 (01/04/2005–31/03/2006)

A paper on the PNG labour force and employment conditions in Madang Province was prepared by the consultant, Dr Gumoi of UPNG, as background to the proposed labour force survey at RD Cannery, Madang. A meeting involving the PNG and Australian Project leaders, National Fisheries Authority (NFA) staff and Dr Gumoi was held at the National Fisheries Authority, Port Moresby on July 19 to discuss the project in general and the design of the labour force survey in particular. The Australian project leader and project staff met with RD officials in Madang on July 20. A further meeting to discuss progress was held at NFA on July 22. NFA staff led by Mr Ronald Kuk made a further trip to Madang to discuss the labour force survey with RD staff. The labour force survey was carried out between November 14 and December 7. A total of 207 employees (approximately 10% of the labour force) was interviewed by three interviewers, supervised by Dr Gumoi and Mr Jerome Tioti of NFA. The survey obtained information on the family circumstances, skills, employment opportunities and working conditions of male and female skilled and unskilled workers. The results of the survey were entered in a spreadsheet file for analysis. The Australian project leader received additional details on the operations of RD Cannery, and preparation of a draft benefit-cost model commenced.

CP/1994/043: Virus indexing and DNA fingerprinting for the international movement and conservation of taro germplasm

Overseas Collaborating Countries	Fiji, Papua New Guinea, Samoa
Commissioned Organisation	Queensland University of Technology, Centre of Molecular Biotechnology, Australia
Project Leader	Associate Professor Rob Harding Phone: 07 3864 1379 Fax: 07 3864 1534 Email: r.harding@qut.edu.au
Collaborating Institutions	Secretariat of the Pacific Community, Fiji Ministry of Agriculture, Forests, Fisheries and Meteorology, Samoa University of Queensland, Australia University of Technology, Papua New Guinea University of the South Pacific, Samoa National Agricultural Research Institute, Papua New Guinea
Project Budget	\$1,576,307
Project Duration	01/07/1998 to 30/06/2007 (Project extended from 01/07/2006 to 30/06/2007)
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Taro is widely grown in Papua New Guinea (PNG) and many other Pacific Island countries. It also plays an important cultural role. The roots are a source of carbohydrate, and the foliage is also eaten. It is cultivated mainly in gardens for local use, but there is also a domestic and export market. Over the last 20 years there has been a gradual decline in the production of taro because of the effects of pests and diseases. Taro leaf blight, caused by a fungus, is the most serious and widespread disease of the plant in Pacific countries. It has long been present in Micronesia, Papua New Guinea and the Solomon Islands, but in 1993 it spread to American Samoa and Samoa with devastating consequences. Many growers have since abandoned taro cultivation in these countries, causing major social and economic problems. Export earnings in Samoa fell from 9.5 million Tala to 158,000 Tala in just one year after the arrival of the blight.

The genetic diversity of taro is poorly known, but some described varieties are resistant to the fungus. In 1993, a breeding program started up in PNG to develop these varieties but the taro germplasm cannot be moved between countries because of the presence of a lethal virus disease known as alomae. It is now important to characterise this disease (which seems to be associated with the presence of two viruses together) and develop reliable tests for the presence of both viruses within taro germplasm. This should then allow free movement of germplasm and thereby help in combating leaf blight and in developing other features of the plant.

Increased knowledge of alomae will be helpful of itself because this disease is now the main constraint on taro production in PNG and the Solomons. Elsewhere it seems that the two viruses do not occur together; when only one virus is present, disease symptoms are much milder. Characterising the virus diseases of taro, a Pacific Island staple crop, is underway as the first step to developing sensitive specific tests for each virus.

The aim of the project is to characterise the virus diseases of taro, a Pacific Island staple crop, and to develop sensitive specific tests for each virus.

Project progress

Year 8 (07/01/2005–06/30/2006)

Improved knowledge of virus epidemiology:

The majority of information dissemination activities are being deferred until the end of the project when more information has been obtained. Discussions and planning for these activities are currently in progress.

Known healthy, but disease-susceptible taro plants are being multiplied in tissue culture for use in transmission experiments. Potential virus vectors are being collected and placed on these healthy plants which are then being examined for virus symptoms.

Known TaVCV-infected taro lines are being multiplied in order to have sufficient numbers to conduct transmission experiments with Tarophagus.

Potential vectors of alomae disease and known virus-infected plants are being multiplied to enable tests to determine the etiology (causes, origins, evolution, and implications) of alomae disease.

Safe distribution of taro germplasm:

This objective relies on the use of PCR-based virus diagnostics at Unitech. New primers and other reagents have been sent to Unitech from QUT. Despite initial difficulties with the diagnostics, it now appears that the problems have largely been overcome. Once the technique has been proven reliable, germplasm can be tested for viruses prior to release.

CP/2000/044: Taro beetle management in PNG and Fiji

Overseas Collaborating Countries	Fiji, Papua New Guinea
Commissioned Organisation	Secretariat of the Pacific Community, Fiji
Project Leader	Mr Aleki Sisifa Phone: 679 3379214 or 679 3370733 ext. 214 Fax: 679 3370021 Email: alekis@spc.int
Collaborating Institutions	CSIRO Entomology, Australia Ministry of Agriculture, Sugar and Land Resettlement, Fiji National Agricultural Research Institute, Papua New Guinea
Project Budget	\$853,855
Project Duration	01/01/2002 to 31/12/2007 (Project extended from 01/01/2006 to 31/12/2007)
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Taro is the preferred staple in Pacific communities. One of the main pests of taro is the taro beetle, which damages the corm (an underground stem resembling a bulb) of the plant and creates entry points for secondary pests. The taro beetle causes about 30 per cent yield loss in taro producing countries such as PNG and Fiji. Taro production is a labour-intensive crop which is grown on a small-scale in farming communities. The spread of the taro beetle in the Pacific is a threat to taro exporters and their revenue, and it also has an environmental impact because infested Taro gardens are abandoned and lead to clearing of established forests for new gardens.

For Australia, the use of fungi such as *Metarhizium* is attractive because fungi are specific, natural and often give persistent control in the soil. However, the use of mycoinsecticides (fungi for insect control) in Australia has been slow because of the lack of suitable products and the high costs. To improve this situation more research is needed to increase understanding of strain selection, mass production, formulation and application strategies.

This project is developing biological controls for the taro beetle, including investigating the combined action of pesticide control and bio-control. It is implementing these methods for taro beetle management in environmentally sustainable cropping systems in Papua New Guinea (PNG) and Fiji. These practices will reduce taro beetle damage in farmers' fields, restore the supplies of taro as a major staple and revive the trade in quality taro in infested countries. This project relies upon bio-control methods that were identified during a previous project: the fungus *Metarhizium anisopliae* (Ma), and the virus *Baculovirus oryctes* (OrV).

Project progress

Year 4 (01/01/2005–31/12/2005)

The Taro Beetle Management programme commenced on 1 January 2002 (actual date of start about June 2002) for duration of 4 years as a component of SPC Pest Management in the Pacific (PMP) programme. PMP, one of the two major projects of SPC-Plant Protection Service, is funded jointly by Australia (AusAID and ACIAR) and New Zealand (NZAID). The other project is Plant Protection in the Pacific (PPP), funded by European Union (EU). PPP commenced on 1 January 2002 for 4 years. Additional Taro beetle activities outside PNG and Fiji are funded by EU-PPP'

2005 was the final year of the 4-year project. All activities as planned were carried out smoothly. The project end review, undertaken in June 2005, came up with the following recommendations :

Recommendation 1. This project should be continued into a second phase centred on participatory adaptive research with the objective of integrating the results of the applied research of phase 1 into sustainable farming systems management practices. Progress should be monitored by impact assessments at the start and end of this phase.

Note: it is suggested that the private sector is integrated into a planning process at an early stage (to share ownership) so that the supply of materials to retail outlets is not a limiting factor and to arouse interest in the commercial production of *Ma*.

Recommendation 2. Whilst insecticides from two groups have proved effective, it is suggested that provision is made in a second phase to permit screening of materials from other groups of insecticides (e.g. organophosphate and carbamate) to ensure that an effective resistance management/prevention programme can be formulated.

The current project has indicated that there are two areas of basic research that will, if successful, enhance the outcome of a second phase. Many scarabaeidae beetles emit potent sex attractant pheromones. They can be applied for monitoring, and lure and kill operations. The latter is of relevance to the needs of atoll and small island communities because they will make it possible to reduce beetle populations without risking the contamination of groundwater as result of applying insecticides to the soil.

Recommendation 3. ACIAR should support a programme to identify the sex attractant pheromone in male (possibly, re *Scapanes australis*) or female beetles and to include the application of this technology as a component of the second phase of the project. This could be considered initially as a separate sub-component, supported in advance of other work.

'Taro beetle' is a complex of two genera and probably more than 10 species. The main species are identifiable by conventional methods, but are extensive in distribution through an unknown number of island habitats. It is possible that isolation has resulted in intraspecific variation. Response to interventions is known to differ between species. There is concern that assumptions about the transferability of technology, especially those concerning *Ma*, may not be valid because of a mismatch between host and disease. DNA analysis technology is available and relatively inexpensive compared to the cost of initiating abortive control programmes on offshore islands. This technique can be based on DNA from museum specimens and/or newly collected material.

Recommendation 4. The project extension includes a component in which speciation and intraspecific separation among taro beetle genera is examined by DNA analysis (fingerprinting).

It is anticipated that the project will generate technology suitable for uptake by extension programmes in a relatively short time, so that the project should engage with development agencies well before a phase 2 is complete. (NB AusAid supports the Agricultural Innovation Grant Facility in PNG, and IFAD is a suitable agency to be approached to support a development program in the Pacific community.)

Recommendation 5. Project managers are to initiate the step up process during a second phase.

Recommendation 6. Whilst some extension material has been prepared for farmers it is suggested that the approach and media adopted for technology transfer is considered carefully and that consideration should be given to an engaging a specialist agency for this purpose.

Recommendation 7. In the proposed phase 2, time should be allocated for the preparation of formal publications of the science in professional journals

The technical progress in 2004 was reviewed at the 5th Taro Beetle Management Technical Coordinators Meeting in November in Fiji.

2005 progress was as follows:

PNG: 12 major activities—six on-station field trials and six on-farm trials; two **supporting activities**—Laboratory trials, Ma fungus low tech production and Ma fungus bio-assay with Ma x confidor in synergy

Outcomes

- Ma fungus can be produced, maintained and mass reared in PNG
- Ma alone is not an effective control measure against taro beetle damage
- Ma x confidor (1ml/L) gives very good control of beetles in both lab and field situation
- Artificial breeding sites were successful in attracting the beetles to breed and rotten saw dust + cow dung and sawdust were the best attractants
- Artificial breeding sites + Ma & confidor in synergy may have a strategic use in atoll situation
- Advanced field experiments on confidor and Bifenthrin insecticides revealed the following
 - Confidor and Bifenthrin applied twice gave excellent beetle control and export taro quality and quantity
 - Bifenthrin double application has no detectable residues in taro corm
 - Confidor has trace in taro corm in high dose (7mls/L) applied twice which is double the optimum dose (3mls/L) for confidor currently in evaluation.
- Farmer surveys confirmed taro beetle is the most serious constraint to taro production followed by soil fertility and disease (leaf blight and pithium).
- On-farm outreach liaison work/trials confirmed keen interest shown by farmers to adopt the new innovation or package.

FIJI

Nine major activities—1 Ma/confidor synergy trial; 1 advanced confidor rate and frequency evaluation trial; 7 confidor multi-location trials. Two **supporting trials**—Ma bio-assay – Ma rates vs mortality and residue analysis potted taro plants treated with confidor at different rates (1, 3, 5 & 7 mls/L) applied once vs twice.

Outcomes

Repeat of trials in Fiji has also shown that Ma on its own cannot control the taro beetle. Insecticides Imidacloprid and Bifenthrin gave very good control of the beetle.

CP/2004/001: TaroPest: A computer based information and diagnostics package for taro pests of the South Pacific

Overseas Collaborating Countries	Fiji, Papua New Guinea
Commissioned Organisation	Queensland University of Technology, School of Natural Resource Sciences, Australia
Project Leader	Dr Anthony Clarke Phone: 07 3864 5023 Fax: 07 3864 1535 Email: a.clarke@qut.edu.au
Collaborating Institutions	Secretariat of the Pacific Community, Fiji National Agriculture Quarantine and Inspection Authority, Papua New Guinea
Project Budget	\$368,533
Project Duration	01/07/2004 to 30/06/2007 (Project extended from 01/01/2007 to 30/06/2007)
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Taro is culturally and economically important in the South Pacific. Culturally it is a staple food, important to food security and as a 'prestige' crop with a role in gift giving and ceremonial activities. Economically it generates substantial returns (in Fiji FJD\$1.85 billion) and creates flow on benefits such as employment and income in rural areas. Taro is also important as an export industry in some Pacific Island countries. Where exporting occurs facilities for packing and shipping can provide jobs, a valuable avenue out of poverty. The main barriers to productivity are pests and diseases. More than 130 pests and diseases have been recorded in the SPC Plant Protection Service database. Many of these cause minor crop losses, but a few can devastate crops, such as leaf blight in Samoa in 1993 which virtually eliminated taro. The majority of pests and diseases are present in only a few countries. This makes the introduction of these to other countries, as in the case of Samoa above, all the more devastating.

The exporting and trade of taro increases the risks of diseases and pests spreading. Quarantine agencies in the region have an important role to play in ensuring this spread is stopped. Diagnostic expertise for quarantine officers, extension workers, farmers and some scientists is lacking. A comprehensive package is needed to help the range of people involved in taro farming, trade and research to better manage pest and disease diagnosis. The project is:

- producing a diagnostic and information package for taro pests and diseases of the South Pacific
- enhancing regional capacity in the ability to build and use Lucid based information and diagnostic packages
- testing and incorporating user feed-back and dissemination of *TaroPest* to end-users

Project progress

Year 2 (01/07/2005–30/06/2006)

The project is progressing well towards the listed goals and outcomes. A beta version of the website is currently online and publicly accessible (<http://taropest.sci.qut.edu.au>). Image collection and completion of the remaining fact sheets is continuing.

Objective 1: The TaroPest website has been publicly accessible since April 2006. Significant effort (announcements on list-servers, articles in international IPM groups, personal emails, hard-copy letters and meeting presentations) has gone into publicising TaroPest and inviting testing and feedback. Hardcopy extension material is currently being developed to provide a print on demand resource. The key and associated fact-sheets and other supporting documentation, the primary objective of this project, are well advanced

Objective 2: Training has been continuing on a virtual basis with regular email contact. No formal training has been carried out in the reporting period.

Objective 3: Since early April 2006, TaroPest has been publicly accessible. We have invited end-users to test and provide feedback on the website and are actively modifying TaroPest in response to feedback on an ongoing basis.

TaroPest can be located through Google search, and this has significantly increased visitors to the site. TaroPest is advertised on the Lucidcentral.org website, and has been the focus of articles in the Taro Growers Association of Australia newsletters, SPC Land Resources Division newsletters, and the Papgren (Plant Genetic Resources News from the Pacific) Forum.

CP/2004/064: Biological control of 'mile-a-minute' (*Mikania micrantha*) in Papua New Guinea and Fiji

Overseas Collaborating Countries	Fiji, Papua New Guinea
Commissioned Organisation	Queensland Department of Natural Resources and Mines, Alan Fletcher Research Station, Australia
Project Leader	Dr Michael Day Phone: 07 3375 0725 Fax: 07 3379 6815 Email: michael.day@nrm.qld.gov.au
Collaborating Institutions	Secretariat of the Pacific Community, Fiji Ministry of Agriculture, Sugar and Land Resettlement, Fiji National Agricultural Research Institute, Papua New Guinea Oil Palm Research Association, Papua New Guinea Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea
Project Budget	\$579,018
Project Duration	01/01/2006 to 31/12/2008
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Food production—both of estate crops (sugarcane, vanilla, cocoa, coconuts, banana, coffee, kava and palm oil) and in food gardens (taro, papaya and green vegetables)—is important for smallholder incomes. This is particularly the case in Papua New Guinea, Fiji and Samoa. Two species of weeds, 'mile-a-minute' and 'giant sensitive plant' threaten these enterprises. Both are invasive weeds, widespread through each country, and capable of smothering food crops. Yields can be significantly reduced, affecting food security. Manual and chemical controls are too expensive for most farmers. This project is evaluating biological control through the identification and release of natural weed predators, based on known agents being trialled or in use elsewhere.

Project progress

First progress report due in 2007.

FIS/1997/031: Pearl oyster resource development in the western Pacific

Overseas Collaborating Countries	Fiji, Kiribati, Solomon Islands
Commissioned Organisation	James Cook University, Department of Zoology, Australia
Project Leader	Dr Paul Southgate Phone: (07) 47815 737 Fax: (07) 47251 570 Email: paul.southgate@jcu.edu.au
Collaborating Institutions	Ministry of Environment and Natural Resources Development, Kiribati WorldFish Center, Malaysia Ministry of Agriculture, Fisheries and Forestry, Fiji
Project Budget	\$1,424,707
Project Duration	01/01/1998 to 31/12/2006 (Project extended from 01/01/2001 to 31/12/2006)
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The small island nations of the Pacific have limited opportunities for export trade. Only non-perishable or high value products are feasible due to their remoteness. The production of black pearl and cultured mother-of-pearl shell have become important industries in some Pacific nations. In French Polynesia the black pearl industry is now their major export earner, with over 2800 kg of cultured black pearls, worth an estimated AU\$164 million, produced in 1994. The Cook Islands are also producing black pearls, earning AU\$5.25 million in the mid 1990s.

Many Pacific island countries, particularly those that are atoll-based, have a strong interest in the development of national pearl oyster culture industries, with several now actively working towards this goal. This is a major priority of the government of Kiribati, along with the Solomon Islands, Fiji and the Cook Islands.

This project follows directly from a previous project that focused on the pearl oyster resources of Kiribati. During that project, which ran from 1993 to 1996, the natural stock of pearl oysters in Kiribati and Fiji was assessed, along with the rates of spatfall of blacklip pearl oysters in the atoll lagoons of Kiribati. Low technology methods for hatchery and nursery culture of the oysters were developed to allow replenishment of natural oyster stocks. Finally practices to improve gem quality of pearls were investigated.

The key elements of this second phase of the project are:

- to further develop and refine hatchery culture techniques for blacklip pearl oysters.
- to investigate nursery and growout technology for use in the atolls and open reef systems of Kiribati and other Pacific nations.
- to examine the rate of spat collection of blacklip pearl oysters and winged pearl oysters in areas of Fiji and determine the growth rate of spat/individuals under culture conditions.
- to produce a simplified manual on the mariculture methods developed for blacklip pearl oysters during the project.
- to develop an appropriate business plan for the establishment of a cultured pearl industry in Kiribati.

This project aims to develop the culture of black pearl oysters and establish an industry to help raise the quality of life of people living in the Pacific atoll islands where there are few potential sources of income or employment.

Project progress

Year 8 (01/01/2005–31/12/2005)

Objective 1: Development towards a cultured pearl industry in Kiribati.

Production of pearls at Abaiang atoll, Kiribati using hatchery-bred oysters

Round pearl production in Kiribati continued during 2005 with the fourth seeding in September. The seeding was conducted for the second time by Ms Berni Aquilina. She also undertook the second pearl harvest. A third will be made in September 2006.

Results of the second harvest in 2005 were disappointing, with pearls being generally small and with only a small proportion showing high quality. These results are similar to those of the first pearl harvest (August 2003). They indicate that the main farm site at Abaiang is not ideally suited for pearl production. This site was initially chosen on the basis of convenience for oyster growout. Slow growth rates of pearls (nacre deposition rate) and poor pearl quality are indicative of low nutrient levels at the farm.

Half pearl (mabe) production at Abaiang was investigated during 2005 as a result of an ACIAR 'Mini Project'. Mabe were harvested at different times and will be analysed for nacre quality and thickness on resulting mabe. These analyses will be undertaken during 2006. The Mini Project also included aspects of training and, subsequent to the work at Abaiang, MFMRD staff conducted a Training Course at Kiritimati Island where they instructed local Fisheries Officers in mabe production techniques.

Establish experimental cultured pearl farms at Abaiang atoll, Kiribati

Two experimental cultured pearl farm sites have been established at Abaiang atoll with further small farm sites established at Abemama, Butaritari and Onotoa. Project staff have also investigated establishing a further farm site at Fanning Island and this may occur in the near future. Research activities in late 2005 and into 2006 focus on establishing a number of small culture sites to investigate resulting pearl quality. The farm site at Abaiang is now thought unsuitable for producing high quality pearls, and a number of seeded pearl oysters will be transferred to more oceanic sites within Abaiang lagoon and to other island sites (Abemama, Butaritari and Onotoa) for further assessment of pearl growth and quality.

*Examine the rate of spat collection of *P. margaritifera* at Kiritimati (Christmas) Island (Line Islands, Kiribati) and determine growth rates of spat/juveniles under culture conditions*

Spat collection studies have been undertaken at Christmas Island. However, insufficient spat have been collected to enable determination of growth rates of spat/juveniles under culture conditions.

Conduct surveys of appropriate islands in the Gilbert group and Kiritimati Island to determine potential sites for future pearl culture

A number of islands in the Gilbert group were surveyed and potential culture sites were identified at Abemama, Butaritari and Onotoa. Small-scale pearl oyster culture was established at all three islands and growth rate data for pearl oysters have been determined.

Facilitate formulation of a cultured pearl industry management and development plan for Kiribati

Two workshops were held in Kiribati as significant steps towards the formulation of a Cultured Pearl Industry Management and Development Plan for Kiribati—the second to fine-tune some of the outcomes and recommendations of the earlier workshop. Various scenarios with transition towards industry development in Kiribati were investigated at the two workshops. The first addressed major issues relating to industry development including:

- modelling to assess the most economic options for industry development (farm size, etc.)
- management issues
- major recommendations for industry development.

At the second Workshop in May 2005 themes developed during the previous workshop were refined and used to provide a basis for revising the draft Pearl Industry Development Plan (2001–2005). Mr. Michael Palmer, who was contracted through Australian Business Volunteers, revised the draft plan during November 2005. He spent three weeks in Kiribati, working with the Kiribati government towards a draft of the Plan, which will form the basis for the development and management of a cultured pearl industry in Kiribati until 2010., It will be finalised during early 2006 then prepared for submission to Cabinet by May 2006.

Objective 2: Produce P. margaritifera spat through hatchery culture in Tonga

Project research in Tonga ceased in 2004 after research showed that it was possible to produce *Pinctada margaritifera* spat using hatchery culture methods. The research also generated basic growth rate information for *P. margaritifera* spat under Tongan conditions. However, unfavourable circumstances (e.g. low water temperature and cyclonic activity) produced far fewer spat than was desired and prevented determination of growth rates under different culture conditions and at different sites of spat.

Objective 3: Produce up to date culture manual for P. margaritifera

A culture manual for *P. margaritifera* incorporating contemporary information from this Project and other sources has remained unfinished for the past four years. The manual is now at the final draft stage and will be ready for publication during the first half of 2006.

FIS/2001/075: Sustainable aquaculture development in Pacific Islands region and northern Australia

Overseas Collaborating Countries	Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, South Pacific general, Tonga, Vanuatu
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Agency for Food and Fibre Sciences—Fisheries and Aquaculture, Australia
Project Leader	Dr Mike Rimmer Phone: 07 4035 0109 Fax: 07 4035 6703 Email: mike.rimmer@dpi.qld.gov.au
Collaborating Institutions	Secretariat of the Pacific Community, New Caledonia WorldFish Center, New Caledonia
Project Budget	\$811,857
Project Duration	01/01/2004 to 31/12/2006
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Aquaculture in the Pacific has been characterised by low production levels and few success stories. The main export commodities are non-food products (pearls and seaweed) due in large part to long transport distances and high costs. Food production has been hampered by the familiar barriers to aquaculture—post larval fish capture and culture having high mortality rates and issues of sustainability and reseeding in sea harvesting. Research has significantly advanced in terms of overcoming these barriers. ACIAR-supported research has addressed some of these issues in grouper aquaculture in Indonesia, developing methodologies applicable elsewhere, including the Pacific Islands. These countries are ideally suited to a range of aquaculture activities, having large, clean and sheltered areas of seawater and high biodiversity.

The Secretariat of the Pacific Community (SPC) has a Pacific Aquaculture Program in place to ensure the continued development of aquaculture in the region. In part this aims to address the reliance of most aquaculture developments on aid donors and domestic government agencies for assistance. The SPC Program will utilise the opportunity to link in with completed and on-going ACIAR and WorldFish work on sea cucumber, including reseeding and post-larval capture and culture of aquaculture species. The results of some of this research will also be applicable for aquaculture in Australian waters, particularly far north Queensland.

The project is providing support to the SPC Pacific Aquaculture Program's strategic development of economically, socially and environmentally sustainable aquaculture in the Pacific Islands region, by:

- identifying and implementing targeted research activities and technology transfer to assist the development of sustainable aquaculture in the Pacific Island region, and
- extending the outcomes of completed and ongoing ACIAR and WorldFish projects to other communities/countries in the Pacific Islands and northern Australia.

Project progress

Year 2 (01/01/2005–31/12/2005)

Significant progress was made on all components and objectives of the project during 2005. The progress summary is presented below under the three core technical components of the project: (a) Miniprojects; (b) Capture and culture of pre-settlement coral reef fishes and invertebrates; and (c) Sea cucumber aquaculture/reseeding.

Miniprojects

Miniprojects development and implementation continued throughout 2005. During the second year of the project, 10 miniprojects were conducted:

- one large miniproject was continued from 2004;
- two small miniprojects commenced in 2004 and were completed in 2005;
- three small miniprojects were commenced and completed in 2005;
- two small miniprojects commenced in 2005 and are due for completion in 2006;
- one small miniprojects has been approved and will commence in 2006;
- the final small miniproject was developed and signed off, but was withdrawn due to problems in the target country.

The projects are:

*Confirmatory testing of the viral status of *Penaeus monodon* (black tiger shrimp) populations in the Fiji Islands*

This project assessed the status of *P. monodon* populations in Fiji for shrimp viral diseases (e.g. IHHNV, TSV YHV/GAV, WSSV and MBV) and determined whether Fiji has populations of SPF shrimp. This knowledge has important implications for the shrimp industry in Fiji and the Pacific.

*Development of commercial and farm-made feeds for tilapia and *Macrobrachium* in PNG and Fiji* This project aims to increase production of tilapia and *Macrobrachium* in PNG and Fiji through development of commercial and farm-made feeds using inexpensive, locally available ingredients. It also involves farm trials of the formulated diets

*Monoculture of the freshwater prawn, *Macrobrachium lar*, in Vanuatu and integrated prawn-taro farming in Wallis & Futuna*

M. lar is an endemic prawn species that could potentially replace the introduced *M. rosenbergii* as an aquaculture species in many Pacific Island countries. This project examined growth and survival rate of *M. lar* in monoculture and in taro ponds—an important first step in assessing its potential for aquaculture.

Rehabilitation of the mariculture research facility at Motupore Island Research Centre, Papua New Guinea

This project assessed the options and costs for rehabilitating the mariculture facilities at MIRC, including the establishment of a quarantine facility.

Microalgae training for Tonga Fisheries technical staff

Training was provided to a member of the Aquaculture staff at Tonga Fisheries for the maintenance and scale-up of microalgae cultures in support of the aquaculture hatchery activities of Tonga Fisheries. This training was also designed to enhance capacity with respect to the proposed culture of *Pteria penguin* pearl oyster. However, the *Pt. penguin* miniproject has since been withdrawn (see below).

Microalgae training for Samoa Fisheries technical staff

Training was provided to a member of the Aquaculture staff at Samoa Fisheries for the maintenance and scale-up of microalgae cultures in support of the aquaculture hatchery activities of Samoa Fisheries.

*Experimental release and monitoring of cultured juvenile white teatfish (*Holothuria fuscogilva*) in Kiribati.*

This miniproject will help determine optimal habitats for release and will monitor survival rates of the released juveniles. Such information is needed to decide whether restocking is a cost-effective and practical management option for restoring white teatfish stocks in Kiribati.

Half pearl (mabe) production in Kiribati

This miniproject will produce mabe pearls in Kiribati to assess their quality, provide appropriate training and produce a product to be used for value-adding activities (i.e. jewellery making).

Village-scale sponge aquaculture in Solomon Islands

This miniproject will assess the potential for sponge aquaculture as a sustainable income option for village communities in the Solomon Islands.

Enhancing the pearl oyster (Pteria penguin) resource in Vava'u, Tonga

This miniproject was designed to address a critical shortage of *Pt penguin* pearl oysters for the pearl industry in Tonga, was developed, accepted and signed off for funding at the end of 2005 but was withdrawn due to problems with hatchery facilities in Tonga.

Dissemination of results from miniprojects has been primarily through the SPC Fisheries Newsletter or specialist Bulletins. A further \$49 000 in funding was requested and received from ACIAR to allow implementation of additional miniprojects.

Capture and culture of pre-settlement coral reef fishes and invertebrates

This component of the project is continuing the activities of ACIAR project FIS/98/13 *Development of new artisanal fisheries based on the capture and culture of postlarval coral reef fish* (referred to as PCC), using WorldFish staff at the Nusa Tupe Field Station, Solomon Islands. Several activities occurred during 2005: WorldFish Center project staff continued to support established PCC operations in two villages in the Western Province of Solomon Islands throughout 2005 with visits by technical staff and assistance with aquarium product exports. Four fisher-farmers on Mbabanga Island sold 641 cleaner shrimp (worth AU\$681), 449 painted lobster (worth AU\$480) and 291 anemone shrimp (worth AU\$314). The principal fisher-farmer, Maraeki Arebaio, and his family accounted for about 96% of production and earned AU\$1,281 in 2005. This is equivalent to over SB\$8,000 which, when compared to an average village income of ~SB\$200 per month, indicates that this fishery can substantially boost rural incomes in Solomon Islands. The Rarumana community successfully lobbied for funds from their National government member and purchased 10 sets of crest nets. These were deployed towards the end of 2005 and income should be forthcoming in 2006.

WorldFish Center project staff conducted a workshop to transfer PCC technology to the town of Buala, Isabel Province. A trial shipment of fish and crustaceans was made which generated AU\$50. A follow-up trip to Kia (also in Isabel Province) was carried out in Nov-Dec 2005. No Operations are established there as yet.

Fiji was selected as the first Pacific Island country after Solomon Islands to receive training in the PCC methods. An initial training trip was carried out in May-June 2005, during which three potential sites were inspected, fishing trials conducted and Fiji Fisheries Officers and community members trained in the techniques. During this trip, good crest net catches were recorded with similar species and abundances to those found in Solomon Islands.

Kiribati Fisheries, Tarawa, have requested PCC training. Discussions are under way to ascertain that they meet the criteria for a PCC operation.

The PCC methods manual for the capture and culture techniques has progressed and a draft manual is nearly complete.

Sea cucumber aquaculture/reseeding

There are three important results from the sea cucumber aquaculture research in 2005:

- Juvenile sandfish produced in the 2004 spawning were on-grown throughout 2005;
- New broodstock were sourced for the 2005 spawning;
- A comprehensive hands-on training course for NFC project staff and trainees from PNG produced in excess of 10,000 settled juvenile sandfish (*Holothuria scabra*).

Juvenile grow-out

About 300 sandfish juveniles from the November 2004 spawning were reared in indoor raceways at NFC until April 2005 before being transferred to bag nets for further grow-out. The bag net grow-out techniques have been developed by WorldFish Center in New Caledonia and used successfully in shrimp ponds. Four nets were used for trials in far north Queensland with small number of juveniles. Two bag net sites were tested: (1) two bag nets with 40 juveniles in each were deployed in a shrimp farm intake channel near Mosman in the wet tropics one hour north of Cairns; (2) two bag nets with 40 juveniles in each were deployed in a pond at the Oonoonba Veterinary laboratory (OVL), four hours south of Cairns in the dry tropics, where broodstock are kept. A further 40 larger individuals were placed in a pen in the same pond at OVL.

Minimal care was given to the juveniles although nets were checked monthly to record growth and survival. In summary, the juveniles in the inlet channel in Mossman showed the best growth and survival. Although it is situated in the wet tropics, this waterway has stable salinity and maintains an algal bloom at most times, providing food for the juveniles. The juveniles grown in the OVL pond experienced variable salinities and infrequent algal blooms (i.e. less food) leading to reduced growth and survival. In July 2005 all juveniles were transferred to the pen in the OVL pond as they were too large for the bag nets. These trials did not provide data for analysis but allowed project staff to gain familiarity with grow-out techniques and to assess the sites proposed for grow-out experiments using the next cohort of juveniles (i.e. planned production from the 2005–06 season).

A Masters Preliminary student from James Cook University used the juveniles for a small project in the last quarter of 2005 that comprised two components—a pond trial and an aquarium trial, both aimed to examine the influence of artificial diets on grow-out of juvenile sandfish. The student plans to use the juvenile sandfish in her Masters studies.

Broodstock

There were a number of developments with respect to broodstock in 2005. All of the 2004 broodstock died in the OVL ponds in February 2005 during a period of very high water temperatures, exacerbated by rainfall and presumed pond stratification. Attempts were made to source new broodstock from Torres Strait and Ayr but these failed and broodstock were eventually acquired again from the Nunukul Ngugi Cultural Heritage Corporation, Moreton Bay.

Training and hatchery production, Oct–Dec 2005

The hatchery manager from WorldFish Center in New Caledonia spent 6 weeks running training in sea cucumber culture at NFC from October to December 2005. As well as transferring the technology to Qld DPI&F through NFC hatchery staff, two trainees from the Conservation International Milne Bay Community-Based Coastal & Marine Conservation Project were taught how to spawn and rear larval sandfish during a 6-week hands-on training course.

Sandfish were induced to spawn by using several or all of the following shock treatments: drying, cold water, warm water and addition of *Spirulina* to the tank. MB Pond broodstock spawned four times from nine attempts and MB Wild broodstock spawned twice from five attempts. Five attempts to spawn Torres Strait broodstock were unsuccessful. A total of 10 tanks of larvae were reared but only two were maintained through to development of juveniles.

One tank of approximately 5500 juveniles was transferred to a raceway conditioned with *Nitzschia closterium* as the final stage of the training course on 11 December 2005. The second tank of an estimated 7000 juveniles was transferred to the same raceway on 22 December. To maintain juveniles, *Nitzschia* was added to the raceway regularly to provide food. In late December, large, fast-growing individuals were transferred to a separate raceway to encourage growth of smaller individuals in the raceway. These juveniles will be used for grow-out trials in bag nets in 2006. Bag nets will be set up in the inlet channel at the Mossman shrimp farm, in an OVL pond in Townsville and in the bioremediation pond of a shrimp farm near Ingham.

FIS/2001/085: Integration of broodstock replenishment with community-based management to restore trochus fisheries

Overseas Collaborating Countries	Samoa, Vanuatu
Commissioned Organisation	Kimberley Aquaculture Aboriginal Corporation, Australia
Project Leader	Dr Chan Lee Phone: 03 9670 0354 (in Vic), 08 9193 7138 (in WA) Fax: 03 9670 0354 (in Vic), 08 9193 3175 (in WA) Email: clee8777@bigpond.net.au
Collaborating Institutions	Department of Agriculture, Forests, Fisheries and Meteorology, Samoa Fisheries Department, Vanuatu Department of Fisheries, Western Australia, Australia
Project Budget	\$466,405
Project Duration	01/07/2002 to 30/06/2007 (Project extended from 01/07/2005 to 30/06/2007)
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The marine topshell *Trochus niloticus*, commonly called trochus, is a large conical-shaped herbivorous marine snail that occurs on shallow tropical reefs in the Indo-Pacific region. It is sought after for its shell, which possesses a thick mother-of-pearl layer that makes it useful for making buttons, inlays and ornaments. Trochus is an economically valuable resource for indigenous and artisanal fishers in the Indo-Pacific region. Since the 1920s, the species has been translocated to almost every island group in the Pacific Ocean. This extensive translocation has resulted in the establishment of substantial fisheries in many locations. However, the translocations did not always result in stock enhancement and sometimes had low success rates.

Research into strategies for restocking trochus has indicated that it is feasible to use broodstock seeding as a tool to re-establish stocks on depleted sites or suitable sites where trochus are absent. To enhance the outcome and to ensure the success of broodstock stocking, community involvement is essential, operating in tandem with community-based management strategies such as customary marine tenure (CMT) (Vanuatu), village-based fisheries management (Samoa) and cooperative management arrangements involving traditional owners in the Kimberley (Australia). This project is using broodstock seeding in tandem with community-based management strategies to establish effective breeding populations of trochus on depleted reefs in Australia's Kimberley region, Samoa and Vanuatu. The ultimate goal is to provide a simple framework so that agencies responsible may implement a nationally coordinated and strategic stock management plan—thus establishing sustainable trochus fisheries through broodstock reseedling, the application of CMT and/or the establishment of marine protected areas (MPAs).

Project progress

Year 4 (01/07/2005–30/06/2006)

Objective 1: Strengthen and reinforce the CBFM framework for community participation in marine resource management

The project continued to reinforce the benefits of the application of MPAs and the community-based fisheries management (CBFM) for establishing/enhancing fisheries in coastal communities in Samoa.

In Australia:

There is no scheduled development activity for communities in Broome, Western Australia. KAAC, the commissioned organisation, has the role of solely managing the extension project in Samoa and assisting the country to establish a trochus fishery in its coastal waters.

In Samoa:

The three MPA sites involved in the previous trochus seeding project in Samoa will be monitored for another two years (July 2005–June 2007) under the project Extension for Samoa. Since the three sites were already managed by the communities under the Samoa CBFM program, this provided an existing platform for continued monitoring of the released broodstock over the next two years. The CBFM will be the basis used for protecting the trochus fishery once it is established.

Linkages with all the communities involved in the project work were done through regular meetings and participation in the project field work. In addition to monitoring the broodstock released in the previous project, 400 juveniles (up to 20 mm in basal diameter) from the Toloa hatchery were released in Foailalo site on Savaii in November 2005.

Summary of results:

The establishment of MPAs and the strengthening of community involvement in CBFM were implemented in Samoa in the previous project. The current extension continued to work with the communities involved to strengthen their commitments to the CBFM. As part of the first year work, a major survey to assess the success of village community involvement in the CBFM was undertaken. The communities involved in the three seeded sites scored higher (mean of 87.5% for the three trochus sites against a mean of 79.5 for all others) in their involvement with the CBFM compared to none-trochus communities.

Objective 2: Monitor seeded reefs for the presence of juveniles

There were two activities under this objective:

- Activity 1: Monitoring of broodstock released in the previous project
- Activity 2: Releasing an additional 300 broodstock in each of the three study sites.

Activity 1

During the year, three surveys of the seeded sites were carried out. Bad weather conditions in the 3rd quarter (S₃) led to the survey being aborted, and a later survey was conducted in July 2006. It is worthwhile noting that some 3.5 years after seeding, many broodstock are still recovered, especially in the Papa-i-Puleia site on Savaii island. The Saoluafata site continues to be a difficult site to survey because of the extensive reef, with live corals in shallow water and strong waves.

It is pleasing to note that the 'replacement survey' on the Saoluafata site in July 2006 found four large juveniles (5–6 cm size) and six of the original broodstock (released in early 2003) averaging 12 cm in basal diameter. Both the F₁ and the adults were collected outside the survey area in shallow reef areas in crevices among rocks and corals.

The result was a most pleasing outcome and vindicated the project and Samoa's Fisheries views that a trochus fishery could be established in the country. The preliminary result confirms previous experience in the Pacific which indicates that the full impact of broodstock enhancement is likely to be apparent only after 5 years or more. Another three surveys of all the sites will be conducted over the next 12 months and the results will be provided in the next annual report.

Activity 2

Sourcing broodstock for the project proved to be surrounded with difficulties. Between September 05 and March 06, SPC, ACIAR Pacific project, Fiji, Vanuatu, Cook Island, and Tonga were approached to assist without much success. Project staff travelled to Fiji in April 06 resulting in some 110 broodstock (12%) provided for the project. Vanuatu Fisheries has confirmed that it will provide the remaining shells needed by Samoa.

No trochus spawning was conducted in Samoa because of the uncertainty surrounding the future of the hatchery. However, some 300 juveniles carried over from the last project were released into reefs in the Foailalo district of Savaii island in November 2005.

FST/2002/097: Identification of optimum genetic resources for establishment of local species of sandalwood for plantations and agroforests in Vanuatu and Cape York Peninsula

Overseas Collaborating Countries	Vanuatu
Commissioned Organisation	James Cook University, School of Tropical Biology, Australia
Project Leader	Professor Roger Leakey Phone: 07 4042 1573 Fax: 07 4042 1319 Email: roger.leakey@jcu.edu.au
Collaborating Institutions	Queensland Forest Research Institute, Australia Queensland Department of State Development, Australia Department of Forests, Vanuatu
Project Budget	\$717,043
Project Duration	01/07/2004 to 30/06/2007
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Sandalwood oil, produced from the heartwood of sandalwood trees is a valuable commodity. The aromatic oil is widely used in perfumery, medicines and incense joss-sticks. The sandalwood tree (genus *Santalum*) occurs throughout South and Southeast Asia, Australia and the Pacific. All are hemi-parasitic on a wide-range of species. Demand for sandalwood oil continues to rise, but over-exploitation of the natural resource base has led to a worldwide shortage.

In Vanuatu sandalwood is found on the western parts of seven islands, the largest quantities on Santo and Erromango. Almost all these trees are of wild origin. Forestry is a vital industry in Vanuatu, with sandalwood royalties accounting for almost half of that paid for all timber species. Most growers on Erromango have small 'garden' plantings of between five and 10 trees as an income supplement. A different sandalwood species has been cultivated for oil, food, fibre and medicinal purposes by Aboriginal communities on Cape York Peninsula. Common problems for both communities are a lack of information and management techniques. In both locations reseedling of improved stock is needed. Increasing information on native forest management, tree improvement, silvicultural systems, value adding and utilisation are all barriers to producing more oil. Morphological characteristics such as variations in oil yields and quality are also poorly understood. Focusing research on these areas is central to this project which is working to stimulate the development of the emerging sandalwood oil industry, through the genetic improvement of the planted resource of *S. austrocaledonicum* in Vanuatu, and *S. lanceolatum* in Queensland.

The project *goal* is to enhance the livelihoods of local sandalwood producers, as well as to stimulate the development of the emerging sandalwood oil industry, through the genetic improvement of the planted resource of *S. austrocaledonicum* in Vanuatu, and *S. lanceolatum* in Queensland.

Project progress

Year 2 (01/07/2005–30/06/2006)

The three key project activities completed during this reporting period were: the delivery of training to village participants during February; the establishment of the 'host' trial in Port Vila; the collection of scion material from the selected trees in the southern islands of Vanuatu plus 25 heartwood cores from the island of Anietyum during June 2006.

(a) A training workshop was organised and held for Vanuatu Department of Forestry staff and one representative from each of the villages participating in the ACIAR-funded sandalwood project. The travel, accommodation and living expenses of the villagers attending the workshop were funded by SPRIG. There were two primary aims of the workshop: (a) to disseminate the results of the research, and participatory development of the sandalwood improvement program; (b) build the capacity of ni-Vanuatu project participants to successfully establish sandalwood plantings.

The training focused on delivery of information on nursery establishment and procedures, sandalwood propagation, plantation establishment and plant improvement. The information was reinforced by practical demonstration and participation in media preparation and seed, cutting and grafting propagation activities. A visit to a sandalwood plantation and oil distillation factory in Port Vila was also arranged to stimulate ideas and information-sharing among participants. Surveys of the workshop attendants, both before and after the workshop, revealed that the aims of the workshop were largely achieved. Most respondents indicated that they had a much better understanding of the processes involved in operating a successful nursery and establishing sandalwood plantations, and many were also enthusiastic in attending future sandalwood training activities.

(b) Success in vegetative propagation of *S. austrocaledonicum* has continued using the non-mist propagator on a range of seedling genotypes. Clonal stocks of these seedlings have increased and will be available for further vegetative propagation over the next reporting period. Comparisons of environmental variables were made between the propagators in Australia and Vanuatu, and this has helped to standardise conditions between the two sites. It is expected that with similar maintenance regimes, success can be achieved in both countries.

(c) A replicated sandalwood x host experiment (868ATH) was established near Port Vila, in collaboration with the Vanuatu Department of Forestry (VDOF) and the Summit Estate sandalwood plantation company. A one-hectare area was selected, surveyed, pegged and planted with 120 host plants each of three species (*Canarium indicum*, *Casuarina equisetifolia* and *Pterocarpus indicus*). A fourth host species (*Micromelum minutum*) was not ready at this time and this will be planted at the end of the year, when the sandalwood trees and an intermediate host (*Sesbania formosa*) are also established. A working plan for this experiment has been completed and provides a comprehensive guideline for experiment establishment activities. Participating VDOF staff gained valuable experience in the research methodologies required to effectively establish a large field trial, recognising and minimising the effects of site and management variability and reducing experimental errors.

(d) Grafts from 19 superior, high-oil yielding, sandalwood trees (identified in a previous project trip) were collected from trees on the islands of Moso (4 clones), Erromango (6 clones), Aniwa (5 clones) and Tanna (4 clones). Unfortunately, additional selected trees on Erromango (2) had been illegally harvested and one tree on Aniwa had suffered fatal damage during a storm. Grafting scions (30–40) were collected from the remaining 19 selected trees, and transported back to Port Vila where a minimum of 20 scions were grafted onto potted, sandalwood rootstock at the VDOF, Tagabe nursery. These grafted trees will be carefully managed to ensure that individuals from each clone survive and can be used to establish the first grafted clonal seed orchard of *Santalum austrocaledonicum* in Vanuatu as the primary component of a new breeding strategy for this species. The Vanuatu Department of Agriculture has agreed to grant exclusive use of a small area of land (50 x 80 m) for establishing the grafted seed orchard. This plot is adjacent to the VDoF nursery in Tagabe and fencing materials are now being sought to secure the block.

(e) An additional *Santalum austrocaledonicum* population on the southern-most island of Anietyum was identified and sampled. Twenty-five trees were located in the villages and surrounds of Anelgehut (12), Utchee (1), Umetch (4) and Enestchei Bay (8). Individual trees were measured, surrounding vegetation (hosts) described, wood cores collected for oil analysis and leaf samples collected for molecular and botanical study. The collection of the Anietyum population completes the population survey of all naturally occurring sandalwood populations in Vanuatu. Analysis of wood cores will identify superior oil yielding individuals in this population for future inclusion in the grafted clonal seed orchard at Port Vila.

FST/2003/049: Review of portable sawmills in the Pacific: identifying the factors for success

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	Australian National University, School of Resources, Environment and Society, Australia
Project Leader	Dr Ryde James Phone: 02 6125 4330 Fax: 02 6125 0746 Email: ryde.james@anu.edu.au
Collaborating Institutions	Secretariat of the Pacific Community, Fiji University of Melbourne, Australia Papua New Guinea Forest Authority, Papua New Guinea Papua New Guinea Ecoforestry Forum, Papua New Guinea University of Technology, Papua New Guinea Ministry of Forestry, Environment and Conservation, Solomon Islands Solomon Islands Development Trust, Solomon Islands
Project Budget	\$149,989
Project Duration	01/04/2005 to 30/09/2007 (Project extended from 01/10/2006 to 30/09/2007)
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Portable sawmills are cheaper to use than conventional mills, causing less collateral damage than conventional harvesting. One important benefit is in allowing small-scale operators to undertake high-quality sawmilling and gain much of the value added in the production of milled forest products. These benefits saw more than 7000 portable mills purchased throughout the Pacific. Less than 20 per cent are believed to be operating effectively. A lack of technical expertise, poor maintenance and market accessibility are behind this low rate. These causal factors are being evaluated by studying a range of mill operations to design strategies for more effective usage. The project has the aim of examining current operations, defining success and guiding the further progress of this technology. Appropriate recommendations will then be provided to key stakeholders for dissemination.

Project progress

Year 1 (01/04/2005–31/03/2006)

This project had a slow start, being first approved in 2003 under the Leadership of Dr Digby Race. While Dr Race's planning was excellent and we are still following his outline, his change of employment and other changes in personnel have meant that progress has been slower than we would have liked. There was also some difficulty in finding a time during which all participants could travel to the field to carry out the actual data collection phase.

To date however the most work-intensive phases have been completed or are in progress. The quality of the investigations that have been done is high and a successful ending to the project is anticipated.

The project has brought together researchers and experts from: The Secretariat of the Pacific Community (Sairusi Bulai—Fiji), the Solomon Islands (Gorgon Konairamo and Terence Titiulu), Papua and New Guinea (Anda Akivi) and Australia (Hartmut Holzknacht, Ken Groves and Ryde James from the Australian National University and Digby Race from Charles Sturt University). The group of experts met in Canberra in July 2005 to plan two visits, to PNG and Solomon Islands, to collect data and to draw up conclusions concerning their findings.

Discussions during the meeting confirmed that a considerable amount is known about the operations of portable sawmills, although this may not be well documented. It seems clear that where portable sawmills are used to mill forest owned by a community, they can be very successful, especially where the product is used to construct houses for the owners or facilities for the whole community. In that case success will not be measured in financial terms and the sawmill may not be used for very long. However community objectives will be satisfied. Indeed this type of use may be amongst the better forms of use for these mills. However the group was aware that the mills could be used in a manner similar to normal commercial operations and that the situation needed to be checked by field observation.

Overview of status of sawmills

This was completed on time by country representatives and the SPC. It provides detailed background information for the Solomon Islands and Papua and New Guinea. This was essential to familiarise other members with the situation on the ground in those two countries. It dealt not only with community-based mills, but also those run as commercial businesses. Even in the case of milling to provide house materials, it is usual to sell some wood to finance the hardware and fittings components of the building. It was therefore suggested that all sawmilling would have a commercial element to it.

As well, some operators of sawmills are entrepreneurs and operate entirely on a commercial basis. Sales can be for internal consumption, but where infrastructure allows, is increasingly for export. The relationship between forest resource owners, mill owners and timber traders (including exporters) is complex. In many cases these are the same people and conflicts do not arise. However there may be some conflicts of interest where they are different enterprises.

It was noted that the rules under which portable sawmills are allowed to operate in PNG and the SI, were designed on the assumption that the mill owner and forest owner were the same. The report drew attention to possible conflicts in the regulations and the way in which they are currently applied. An assessment of previous reports on this subject has been prepared by Ken Groves and Hartmut Holzkecht. Coordination of the two sections of the report is nearing completion.

Field visit to PNG

In April 2006 most of the team visited PNG. After an "Inception Meeting" in Port Moresby to inform officials of the PNG Forest Authority and others about the purpose of the trip, the team moved on to the provincial office in Lae and also inspected mills in the environs of Port Moresby, Lae and the head of the Markham Valley near Goroka. Members attended a one-day seminar of forest and mill owners in Lae and met members of NGOs in Port Moresby, Lae and in the field.

Tentative conclusions

The technology of sawing has been mastered sufficiently well in PNG for us to say that although it was not perfect, this is not where the major problems lie. Training schemes exist through the Timber Industry Training Centre in Lae, and also from mill suppliers, so that the operators that we observed were all capable of using their mills. Forest owners were producing timber by themselves, or with the aid of NGOs. Houses were being built from this timber and the aims of the people were being satisfied.

Faults which did exist with the sawing process largely concerned the way in which sawing impinged on other values such as forest management. Selection of trees to harvest was based entirely on convenience of location and of the marketability of the species. The degree of utilisation of felled trees could be poor especially when logs that were inconvenient to saw were just left. Utilisation was therefore lower than desirable, both because of difficult logs and because only timber sizes which suited the market (house lots) were taken; the rest being wasted. Care of boards after sawing was often rudimentary, but the species used were of such high quality that the timber did not deteriorate.

It should be noted that all these faults were understandable. Possibly the easiest part of the process was the actual sawing. Transport of the mill to the fallen tree over steep terrain was difficult; as was carrying out the sawn produce. Many comments were made at meetings that using a portable sawmill was actually 'back-breaking' work. Unfortunately, in PNG, humans still do manual work that in developed countries is left to machines. However, the problem areas were in the social, economic and regulatory fields. Social cohesion varied amongst the people of PNG as it does anywhere. Some family groups were very well organised but other groupings could be less so and the use of portable sawmills could fail or be successful on those grounds alone. In only the EU-funded 'Eco-Forestry' project did we see milling where the trees had been selected on proper silvicultural criteria. In terms of judging success, the mills appeared to be more successful than had previously been supposed. However the criteria were not simply economic. If a mill had been bought so that the owners could saw enough timber to build a house, and this had happened, then the mill was regarded as a success and the fact that it was no longer used should not represent failure. The mill owners had often not acquired the mill to become sawmillers but rather to become house owners. Once the house had been built, then the project was regarded as successful; at least by the house owner. If the mill did not make a profit in terms of finance, then it could still be successful—particularly if the mill was used by another potential house-owner.

On the other hand PNG mill owners showed only a short-term awareness of finance, often making too little allowance for longer-term effects such as costs of repairs or replacement of parts. Running costs such as fuel and sharpening of saws were also often neglected.

The legal regulations under which portable sawmills operate in PNG need to be revised. It was intended that the mills could operate completely without regulation if their cut was less than 500 m³ per year, the reasoning being that the volume was too small to be a problem and the owners were cutting their own forest anyway. In fact, mill sponsors were using this quite high figure to purchase timber from many mill 'owners' whom they had sponsored. It was said that one person had sponsored or owned 11 such mills and one we met admitted that he had bought one mill that was so profitable that he was going to buy another. It was suggested at the seminar held in Lae that the system would work better if a zero could be knocked off the figure; i.e. down to 50 m³. It was also suggested that instead of a volume, permission to mill might be better defined by land area and that this value should vary by the type of ownership group, i.e. family, clan or larger community.

Portable sawmill owners were not organised and a Portable Sawmill Owners Association would be helpful; for advice when recasting the regulations and perhaps for some degree of self-regulation of activity. The areas that needed more work were seen as: social organisation of owner groups, forest operations (especially how trees were chosen to be felled), business arrangements and the regulations for small mill exemptions.

Whether these conclusions are confirmed as a result of the trip to the Solomon Islands has yet to be seen. However the group felt that we had learnt a great deal from the trip that would assist us to derive positive conclusion for the way forward.

FST/2004/053: Establishing forest pest detection systems in South Pacific countries and Australia

Overseas Collaborating Countries	Fiji, Vanuatu
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Dr Ross Wylie Phone: 07 3896 9781, mobile: 0408459344 Fax: 07 3896 9567 Email: ross.wylie@dpi.qld.gov.au
Collaborating Institutions	Forestry Tasmania, Australia Secretariat of the Pacific Community, Fiji Ministry of Fisheries and Forests, Fiji Vanuatu Quarantine and Inspection Services, Vanuatu Department of Forests, Vanuatu Ministry of Agriculture, Sugar and Land Resettlement, Fiji
Project Budget	\$399,526
Project Duration	01/01/2006 to 31/12/2008
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

The aim of the project is to reduce the risk of serious damage by exotic pests to the valuable timber resources of Fiji, Vanuatu and Australia by establishing efficient detection systems for target pests in high hazard sites. Simple and robust technologies involving static trapping systems and sentinel plantings are being developed. In particular, the project aims to minimise losses in the valuable plantations of Fiji and the emerging plantation industry of Vanuatu. Some major target pests are the cedar shoot caterpillar, wood and bark beetle pests of pines and hardwoods, lepidopterous defoliators (moth and butterfly larvae), guava rust and *Erythrina* gall wasp. This is part of a 'neighbourhood watch' approach to incursion management that will benefit all regional countries, including Australia.

Project progress

First progress report due in 2007.

FST/2004/055: Domestication and commercialisation of *Canarium indicum* in Papua New Guinea

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	James Cook University, School of Tropical Biology, Australia
Project Leader	Professor Roger Leakey Phone: 07 4042 1573 Fax: 07 4042 1319 Email: roger.leakey@jcu.edu.au
Collaborating Institutions	National Agricultural Research Institute, Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea Commodities Export Marketing Authority, Solomon Islands Kastom Gaden Association, Solomon Islands Pacific Nuts Co., Vanuatu
Project Budget	\$634,571
Project Duration	01/01/2006 to 31/12/2009
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

The feasibility of domesticating and commercialising the canarium nut in Papua New Guinea was established by past ACIAR research. Building on those findings is the aim of this research; to ensure sufficient supply of *Canarium indicum* and establish a network for this. The nut is currently used for food but supply falls well below demand. Selecting cultivars that produce nuts regularly and are heavy fruited will close this gap. Establishing robust nursery propagation techniques using low-cost systems suitable for community and village uptake will help create a more regular supply of high quality fresh nuts that can underpin the development of a marketing network.

Project progress

First progress report due in 2007.

HORT/2001/023: Horticulture industry development for market-remote communities

Overseas Collaborating Countries	Samoa
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Mr Rowland Holmes Phone: 0747830409 Fax: 0747833193 Email: rowland.holmes@dpi.qld.gov.au
Collaborating Institutions	Ministry of Agriculture, Forests, Fisheries and Meteorology, Crops Division, Samoa
Project Budget	\$399,560
Project Duration	01/07/2003 to 31/12/2006 (Project extended from 01/07/2006 to 31/12/2006)
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

Remote tropical communities undertaking horticultural activities must carefully choose what enterprises they invest in, with this decision including reference to the distance of these communities from markets. Where infrastructure is poor or non-existent only produce with a longer shelf life and good chance of surviving to market can be grown. Perishable commodities will not survive and reduce or destroy profitability. Technical research has made advances in improving both pre and post harvest management of a variety of horticultural produce. Many of these advances impact positively on shelf life, making up for under-developed supply chains and also enhancing development of these chains. Quality management systems are of great importance, generating improved practices and efficiencies throughout the supply chain.

Information packages are the key to delivering these improvements, and to the industry's long-term sustainability. Remote communities in Samoa and Cape York Peninsula in Australia stand to benefit from information to influence choices of what fruit to grow and how to deliver improvements to the supply chain. Aboriginal communities in Cape York make decisions on land use through locally elected councils and by the traditional owners of the land, influenced by their elders. In Samoa the 'Matai' system of community ownership and family headship makes it imperative to have information on options available. Family heads make decisions that apply to community land, making it necessary for individual farmers to work with and within this context.

A decision that does not cater to infrastructure, supply chains and other realities can significantly hamper even the most efficient individual producers in both Samoan and Australian communities. Fostering the sustainable development of horticulture to supply local and distant markets (in Samoa and Cape York Peninsula) is being achieved by enhancing capacity for the development and use of technical information by researchers, extension personnel and farmers.

Objectives of this project:

- To foster the sustainable development of horticulture to supply local and distant markets (in Samoa and Cape York Peninsula).
- To enhance capacity for the development and use of technical information by researchers, extension personnel and farmers.

Project progress

As at October 2006 the progress report is forthcoming, the previous report has been included for information.

Year 2 (01/07/2004–30/06/2005)

Subproject/objective 1.1: Research information use and needs

A series of card sort interviews and several participatory rural appraisals have been conducted with the target groups in Samoa. The main issues raised by Taro growers during the interviews were the identification of new varieties and managing and identifying pest and diseases without the excessive use of chemical pesticides. Papaya growers wanted more information on growing, husbandry, harvesting and grading standards for papaya as well marketing information such as identifying export markets and price.

Issues relating to packaging and labelling were the main concern for Agro-processors. Finding and accessing information on CODEX and food safety was also an issue for this target group. Overnight storage of produce and maintaining quality and shelf life of produce were the main issues for the roadside stallholders. The need for better record keeping has also been identified to help stallholders access financial assistance to develop their businesses.

In northern Australia a series of informal interviews were conducted with a wide cross section of the Mapoon community and the key personnel involved with the community farm at Napranum. These interviews helped define their interests in horticulture (both growing and using) and identifying information sources within the community and those external to the community.

Card sort interviews, focus groups and farm visits were held with commercial growers in the Cooktown area. The need to customise a wide range of horticultural information to take advantage of unique market windows and reduce the impact of the harsh environmental growing conditions were the main issues identified by growers. Selection of varieties and methods of growing and managing specific crops were highlighted.

Subproject/objective 1.2: Develop information strategy

An information strategy is currently being developed using the concept of 'Agricultural Knowledge and Information Systems' (AKIS). Using AKIS, the project team is mapping the 'Information supply chains' used by specific target groups, to identify the key information sources, providers and repositories and to investigate importance of the relationships in the dissemination and use of information.

Subproject/objective 1.3: Develop and distribute information kits

A series: Peninsula garden notes; Native food plants; Ornamental crop notes; has been developed and distributed to target growers and communities in both Cape York and Samoa. In Samoa, a number of crop management notes covering papaya and taro were produced and will be translated into Samoan. Taro variety sheets were developed for 14 different varieties with a further 6 planned. A project newsletter keeps stakeholders and others interested up to date with project activities.

Subproject/objective 2.1: Capacity development of extension staff (Samoa)

Training in the use of card sort interviews and focus groups as social research methods was conducted during project visits to Australia and Samoa. These research processes were field tested and modified to help the project team identify the key issues in relation to the access and use of horticultural information relating to decision making.

Subproject/objective 2.1: Enhancing capacity to produce targeted information products (Samoa)

Digital camera workshops were run in Ayr and Innisfail coinciding with project visits from Samoa. The workshops' focus was on improving the knowledge and skills of the project team in relation to both print and digital photography. The workshops also covered basic manipulation of images on the computer as well as managing and archiving digital images. So far the project has produced over 5500 digital images for information products.

A series of computer training workshops with Samoan project staff was conducted during Australian project team visits. Training focused on using Word and PowerPoint as publishing tools and creating document templates. During project visits to Australia, examples of horticultural information sources and systems featured heavily, to help the project gain an understanding of how information is accessed and used. DPI&F information centres, Call Centre, Growsearch and Market Information Services provided significant insights into information providers. As a result, Crops Advisory division (MAF) investigated the establishment of two Horticulture Information Centres.

HORT/2003/046: Integrated control of powdery mildew and other disease, weed and insect problems in squash in Tonga and Australia

Overseas Collaborating Countries	Fiji, Tonga
Commissioned Organisation	University of Sydney, Faculty of Agriculture Food and Natural Resources, Australia
Project Leader	Dr Robyn McConchie Phone: 02 9351 4332 Fax: 02 9351 4172 Email: r.mcconchie@usyd.edu.au
Collaborating Institutions	Ministry of Agriculture, Forestry and Food, Tonga Secretariat of the Pacific Community, Fiji
Project Budget	\$456,470
Project Duration	01/01/2005 to 30/06/2008
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

Agriculture is a vital contributor to the economy of Tonga. It is the leading employer, foreign exchange earner and is essential to food security. The leading agricultural export is squash, earning \$10.8 million in 2002. Squash is quick and easy to grow with a clear market in exports to Japan. In recent times other export industries in the agriculture sector have suffered due to pest and disease problems, making squash even more vital. These disease and pest problems are now beginning to reach threatening levels in the squash sector too. Controls against pests and diseases have been less effective. In turn this has increased pesticide usage, resulting in pesticide resistance emerging. The use of pesticides also has implications for Tonga's water supply, which is particularly vulnerable to water-borne pollutants. The prevalence of diseases and pests has reduced the industry by close to two-thirds, from 2000 active farmers in 1987 to an estimated 550 in 2003.

Powdery mildew is the main disease. Outbreaks defoliate crops, in turn making plants more vulnerable to silver leaf white fly, other viruses and weeds. Current fungicides against powdery mildew are unreliable, with increasing resistance reported. Past ACIAR research has demonstrated the value of integrated approaches to controlling powdery mildew. These are applicable to Tongan conditions and, along with pest controls targeting white fly and disease controls against viruses found in squash, have the potential to significantly rehabilitate the industry. The sustainability of the Tongan squash industry is being addressed through improvements to integrated disease, pest and weed management, specifically to improve field-based crop protection and market quality of squash within a systems framework.

Project objectives are to foster the sustainability of the Tonga squash industry through improvements to integrated disease, pest and weed management, specifically to improve field-based crop protection and market quality of squash within a systems framework addressing: powdery mildew; silverleaf whitefly; virus management; weed management; grower uptake and market implications

Project progress

Year 1 (01/01/2005–31/12/2005)

Tonga

A field investigation into control of powdery mildew using fungicides generally regarded as safe (GRAS) chemicals and inducers of natural resistance was conducted this season from July to October 2005. Powdery mildew severity was relatively mild this season. The most effective fungicide in this trial was Talius (both high and low rates) followed by Punch+Afugan, Sulphur, JMS stilet oil, Actigard and the Control (untreated). Exportable yield in t/ha was highest in Talius treatments with 17.21 (low rate), 15.30 (high rate), 13.29 (Punch+Afugan), 12.71 (Rubigan), 12.20 (Sulphur), 11.29 (Actigard), 11.01 (JMS stilet oil) and 10.96 (Control). Sugar content was highest in the Punch+Afugan replicates with 9.81%, Actigard (9.64%), Rubigan (9.40%), JMS stilet oil (9.39%), Talius [high (9.15%)], Sulphur (9.08%), Control (8.70%) and the lowest sugar content was recorded in Talius [low (8.61%)].

Australia

An objective powdery mildew screening procedure was developed using a scanning program to assess percentage severity. Six cultivars of squash—Kabocho SPS8682, Kabocha SPS3742, Kabocha Amali Delica 2643R3KQJ, Kabocha SPS7764, Kabocha SPS8702, Hybrid Japanese Kurijiman F₁—were screened for resistance to powdery mildew. All were susceptible with no evidence of partial resistance. In glasshouse trials, whole leaf and detached leaf screening of GRAS and defence elicitors was conducted for control of powdery mildew prior to conducting a field trial. Milsana, Thiovit, Silica, an organic oil product GC3, an oil product Biocover, Actigard, and Ti Tree oil, were used and the best treatments selected for use in a field trial in late 2005. In separate trials optimum concentrations of Milsana and silica for PM control was determined. Milsana and Thiovit were significantly better at controlling powdery mildew in the preliminary trials. For the field trial, an integrated approach was developed in testing efficacy of both Milsana and Thiovit against conventional fungicide treatments. Treatments were: Milsana, Thiovit, Amistar, alternate Milsana + Thiovit, alternate Thiovit + Amistar, alternate Milsana + Thiovit + Amistar, Water and Surfactant, and Commercial Practice. The trial was completed in March 2006 and is currently being analysed.

HORT/2003/047: Improved plant protection in the Solomon Islands

Overseas Collaborating Countries	Solomon Islands
Commissioned Organisation	Secretariat of the Pacific Community, Fiji
Project Leader	Mr Stephen Hazelman Phone: 679 3370733 Ext 258 Fax: 679 3370021 Email: stephenh@spc.int
Project Web Site	http://www.pestnet.org/ ; http://www.terracircle.org.au/team/rk.html ; http://www.terracircle.org.au/projects/kg/kga.html
Collaborating Institutions	Department of Agriculture and Livestock, Solomon Islands Kastom Gaden Association, Solomon Islands Vois Blong Mere Solomon, Solomon Islands
Project Budget	\$408,960
Project Duration	01/01/2005 to 31/12/2007
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

Food security in many areas of the Solomon Islands is built on subsistence agriculture. Root crops are the staple foods, along with fruit and nut species and leaf and other vegetables. Agricultural production involves more than 80 per cent of the population, with women the main food producers. Surpluses of food, when produced, are usually sold to meet household expenses. One of the major problems faced by most smallholder farmers is pests; another is diseases attacking crops. For pests the main controls are pesticides, but these are expensive. Buying pesticides means foregoing income that could be spent elsewhere, especially on household needs. Pest and disease problems are particularly prevalent in rural areas with high population densities.

Exacerbating these problems is the breakdown and loss of infrastructure reflecting the broader declines in infrastructure during the civil unrest and tensions of recent years. The main Department of Agriculture and Livestock research complex was destroyed by fire in 2000 and the remaining facilities lack resources.

With both the farming and research community lacking resources to address pest and disease management the project is rebuilding these areas by:

- developing integrated pest management (IPM) strategies for major food crops.
- increasing the awareness among government staff and the community about plant pests and diseases, leading to improved and sustainable crop management.

Project progress

First progress report due in 2006.

HORT/2004/049: Improved farming systems for managing soil-borne pathogens of ginger in Fiji and Australia

Overseas Collaborating Countries	Fiji
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Queensland Horticulture Institute, Australia
Project Leader	Dr Mike Smith Phone: 07 5441 2211, 07 5444 9630 Direct Fax: 07 5441 2235 Email: mike.smith@dpi.qld.gov.au
Collaborating Institutions	Biological Crop Protection, Australia Buderim Ginger Ltd, Australia Secretariat of the Pacific Community, Fiji Ministry of Agriculture, Sugar and Land Resettlement, Fiji
Project Budget	\$595,888
Project Duration	01/01/2006 to 31/12/2009
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

Ginger farming is inundated with problems related to increasing soil-borne pathogens. Fiji and Australia have been affected severely in recent years with declining crop yields and poor rhizome quality.

Edible ginger (*Zingiber officinale*) is grown as an annual crop in Fiji and Australia with harvests coinciding with market and factory demand. 'Seed-pieces' are also harvested and used for planting next season's crop. A major constraint to production in Fiji is the soil-borne pathogen *Pythium myriotylum*, which infects seed-pieces and causes rot and early death in plants. In Australia the major soil-borne pathogen of edible ginger is *Fusarium oxysporum f. sp. Zingiberi* that is also responsible for extensive rhizome rots. Annual farm-gate losses due to soil-borne pathogens are currently estimated at FJ\$530,000 for Fiji and AU\$990,000 for Australia with the situation deteriorating.

The major focus of this project is to find farming systems that can restore the chemical, physical, and biological fertility of the soil. Reducing inoculum density and managing resident microbial antagonists that modulate the state of disease suppression in soils may be achieved by various rotational practices, as well as through the use of mulches and organic amendments.

The introduction of a minimum tillage system for mechanised ginger production systems is a novel approach that warrants testing because of its role in conserving organic matter. It has not been investigated before and builds on the success of minimum tillage in other industries. Due to differences in key pathogens; soils, climate and level of mechanisation; the farming systems that are feasible in Australia and Fiji differ. In both cases, farming systems are being built on well-established principals of creating good soil health. Practices such as biofumigation and plant defence activators such as silicon will be included within the farming system.

Treatments are being evaluated by measuring a range of standard soil physical, chemical and biological properties and by measuring the effects of treatments on yield losses due to nematodes and soil-borne pathogens. Clean seed trial blocks are being established to promote and demonstrate the value of clean planting material in managing soil-borne pests and diseases. There is an urgent need to break the 'diseased plant–diseased seed–diseased plant' cycle.

The overall aim of the project is to improve profitability and yield quality of ginger in Fiji and Australia through better management of soil-borne diseases.

Project progress

First progress report due in 2007.

HORT/2004/063: Integrated pest management in a sustainable production system for brassica crops in Fiji and Samoa

Overseas Collaborating Countries	Fiji, Samoa
Commissioned Organisation	University of Queensland, School of Integrative Biology, Australia
Project Leader	Dr Michael Furlong Phone: 07 3365 4822 Fax: 07 3365 1655 Email: m.furlong@uq.edu.au
Collaborating Institutions	Secretariat of the Pacific Community, Plant Protection Service, Fiji Ministry of Agriculture, Sugar and Land Resettlement, Koronivia Research Station, Fiji Ministry of Agriculture and Fisheries, Research and Extension, Crop Division, Samoa Queensland Department of Primary Industries and Fisheries, Gatton Research Station, Australia
Project Budget	\$595,808
Project Duration	01/07/2005 to 30/06/2010
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

In the Pacific islands both large landholders and smallholder farmers grow brassicas—mainly head cabbage, Chinese cabbage and watercress. The production of these crops has increased dramatically in Fiji and Samoa, where Chinese cabbage is rapidly becoming the major source of green leaf vegetable. But producers must combat diamondback moth, the leading pest of brassica crops. With brassica production increasing in recent years, opportunities have increased for the moth to spread, and insecticides have been the main forms of control.

Integrated pest management (IPM) approaches that limit insecticide use while maintaining control of diamondback moth have been used elsewhere in the world. Pacific islanders need an IPM program with local relevance. But successful IPM programs developed in Southeast Asia cannot simply be transferred to Fiji and Samoa, due to regional differences in behaviour between the pest complexes, inadequate knowledge of the structure and function of local natural enemy assemblages and important differences in climate.

This project is designed to increase knowledge of the moth and to develop appropriate IPM packages for each collaborating country. Its main objective is to facilitate the adoption and uptake of IPM as a component of sustainable agricultural management systems for brassica crops in partner countries. It is seeking to determine the composition and efficacy of the natural enemy pest complexes of brassica insect pests in Fiji and Samoa, and how to integrate this natural resource with other pest control tactics to develop sustainable brassica crop protection programs.

Project progress

Year 1 (01/07/2005–30/06/2006)

Objective 1: To demonstrate effective integrated approaches to Brassica pest management

Due to the unavoidable delay to the start of project activities, the workshops and farmer extension sessions were postponed; they will now be held in early September 2006. Despite the delay several stakeholder and technical meetings were held in November 2005; these established an introduction to the project and preliminary planning sessions were conducted (additional technical meetings were held in June 2006—Objective 3).

Seminars and discussion groups were held to introduce stakeholders to the project's approach and goals at:

- SPC, Suva (Fiji) The meeting was attended by approximately 20 stakeholders including farmers, SPC and MASLR extension officers and officers from the Fiji Ministry of Health. In an additional meeting, technical aspects of the project were discussed by MASLR, SPC, University of Queensland and QDPI&F project team members.
- Nu'u crop research station (Samoa) The meeting was attended by approximately 15 stakeholders including farmers, MAF, SPC, University of Queensland and QDPI&F technical and extension staff. In a supplementary technical meeting, project team members (MAF, SPC, UQ and QDPI&F) discussed issues related to the project for the coming 2006 season.

The participatory trials to demonstrate the essential elements of effective *Brassica* IPM trials have not yet been set up but they will be conducted to coincide with the planned workshops in early September in both Fiji and Samoa.

Objective 2: The introduction of a FFS approach for improved sustainable production systems in Brassica crops and effective communication of project outputs

A possible master trainer for the training of local extension officer personnel in FFS techniques has been identified, training sessions are expected to begin in the current crop season. Appropriate community/farmer groups have been identified for the basis of FFS in Fiji and Samoa. It is anticipated that training will have begun and be ongoing by the time of the September workshops; the first field testing of the toolkit will be undertaken around the workshops. Team members in Fiji and Samoa regularly liaise with DSAP team members. A key member of the IPPSI project team is now a PhD student at the University of Queensland, and this close link between personnel between both projects will ensure effective bilateral information exchange and cooperation.

Objective 3: To determine the role of major natural enemies in the management of Brassica crop pests

Regional surveys (on farms and research stations) to determine the key insect pests of *Brassica* crops and their associated natural enemies began in June 2006 in both Fiji and Samoa. Continuous data collection for the next two years (June 2006–May 2008) will build up this inventory. Local scientists have received training relating to survey techniques and insect identification.

Preparations for experiments to determine the impact of relevant natural enemies on populations of diamondback moth are under way in both countries. The experiments will be performed later this season and will provide valuable preliminary information regarding the structure and function of the endemic natural enemy complexes in the *Brassica* agro-ecosystems of both countries.

Preliminary data indicate that some important natural enemies of the diamondback moth are present in both countries. Arrangements have been made to receive a population of a heat-tolerant biotype of *Diadegma insulare* from Florida into the quarantine facility at the University of Queensland. Experiments have investigated the relative foraging efficiencies and survival of adult and immature *D. semiclausum* at a range of temperatures. Preliminary results indicate that *D. semiclausum* forages effectively at temperatures up to 25°C, however at temperatures of 25°C and above successful development to adult stages is severely disrupted. Suitable protocols for comparing the performance and survival of *D. semiclausum* and *D. insulare* at a range of temperatures in the laboratory have been devised.

Objective 4: To develop a refined local IPM strategy using selective plant protection products

Selective plant protection products have been sourced and transported to Fiji and Samoa for testing. Products will initially be tested in the laboratory and then field tests will be conducted accordingly. In Australia, laboratory tests on the relative efficacy of a Neem formulation against *P. xylostella* and *C. pavonana* are currently under way. These preliminary experiments will be complete by the workshops in September and results will be discussed with team members.

Current action thresholds for intervention are based on the assessment 'standard' insect measurements. These relative values are based on the total foliage consumption by first to final stage larvae of each species. Preliminary experiments measured the relative foliage consumption of *P. xylostella* and *C. pavonana* in the laboratory. Individual *C. pavonana* larvae consumed approximately 13 times more cabbage foliage than individual *P. xylostella* larvae. Based on the standard insect assessment, one *C. pavonana* larva represents 2.6 standard insects.

LPS/2003/054: Feeding village poultry in the Solomon Islands

Overseas Collaborating Countries	Solomon Islands
Commissioned Organisation	South Australian Research and Development Institute, Pig and Poultry Production Institute, Australia
Project Leader	Dr Phil Glatz Phone: 08 8303 7786 Fax: 08 8303 7689 Email: glatz.phil@saugov.sa.gov.au
Collaborating Institutions	Kastom Gaden Association, Solomon Islands Department of Agriculture and Livestock, Solomon Islands National Agricultural Research Institute, Papua New Guinea Solomon Islands College of Higher Education, Solomon Islands
Project Budget	\$432,294
Project Duration	01/01/2005 to 31/12/2007
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

Village poultry is a vital source of food security and, in many cases, supplemental income for smallholder farmers. In Solomon Islands an estimated 22,000 families have poultry, producing 210,000 birds and 2.64 million eggs a year. Both live birds and eggs are sold, usually in local markets. Poultry production by village families has considerable scope for improvement. Only one bird is consumed on average each month along with some eggs, with this likely to vary given other enterprises and income streams. An average 30 per cent of infants are underweight with malnutrition the cause, despite an available source of protein and nutrition through eggs and birds. Two main barriers exist to increased production: better feeds and the size of the average family's flock.

Kastom Gaden Association (KGA), a local NGO, estimates that between 20 and 40 chickens per family would allow eggs to be eaten and sold each day as well as a regular consumption of chicken meat. Existing feeding systems, however, limit the number of chickens that can be run. This is despite a wide variety of local feed resources being available, including root crops, fruit and native plants. Identifying feeds for village chickens that would result in a higher nutritional intake and more cost effective poultry systems will produce more birds and eggs. This will boost income and begin to change the current system, ensuring more chickens are run and families see greater financial and dietary returns.

The project is developing improved systems of village-based poultry production, through:

- identifying rations for village-based layer and meat birds based on locally available feedstuffs.
- interacting with farmers and farmer groups to evaluate, disseminate and communicate the value of rations based on local feedstuffs.

Project progress

Year 1 (01/01/2005–31/12/2005)

In Solomon Islands:

Objective 1: To develop rations for village-based layer and meat birds based on locally available feedstuffs.

To enable assessment of village poultry rations it was necessary to develop a poultry production research unit in the Solomon Islands (SI). In May, 2005 SI collaborators Tony Jansen (Kastom Gaden Association-KGA) and Nick Nonga (Department of Agriculture and Lands-DAL) visited Lae to view the National Agriculture Research Institute (NARI) research facilities. They followed this with a visit to Roseworthy with Russell Parker (SI consultant) to examine the poultry facilities at the Pig and Poultry Production Institute (PPPI) and plan the research facility required in the SI with poultry scientists from the South Australian Research and Development Institute (SARDI). In June 2005, Phil Glatz and Bob Hughes from SARDI and Pukah Kohun from NARI visited the SI.

After discussion amongst all collaborators it was decided to establish the production unit at the SI College of Higher Education (SICHE). The rationale for this (apart from developing research capability) was to encourage training of students in poultry production and to further strengthen the links between key staff from DAL, SICHE and KGA. Land was also available on the SICHE site to plant crops to test different feed resources in village poultry rations. Crops planted for nutritional evaluation were sorghum, pigeon peas and cowpeas. Construction of SICHE/DAL 16 pen poultry research facility (made from local materials) is almost complete with only perches, nest boxes, drinkers and feeders to be installed.

KGA's poultry training facilities and DAL's Abulo Farm have been upgraded to enable village birds to be reared on site to supply stock to the SICHE research facility. These facilities at KGA and Abulo farm will be used as demonstration and training sites in Honiara for village farmers. A demonstration trial with village poultry is being conducted at the KGA facility comparing a free choice diet with a mixed diet. The diet comprises sorghum (30%); pigeon pea (30%), fresh coconut (20%), pigeon pea leaves (10%), and paw paw leaves (10%). SARDI has prepared dietary fact sheets on a range of SI feed ingredients and distributed to all collaborators. This information will assist with the formulation of diets to test in the SI research and demonstration facilities.

Objective 2: Interacting with farmers and farmer groups to evaluate, disseminate and communicate the value of rations based on local feedstuffs.

A survey form that was used by NARI to obtain information from PNG smallholder farmers on chicken feeding practices in project LPS/2001/077 was used as the basis for developing the survey questions in the SI. The project team modified the questions to cover village poultry practices in the SI. During Oct and Nov 2005 DAL and KGA staff interviewed up to 80 village poultry farmers in Malaita, Guadalcanal and Western Province. Information was obtained on farmer's attitudes, constraints and needs in keeping village poultry. The data from the survey will be collated and analysed by SARDI early in 2006. KGA hosted three farmer attachments at Burns creek while the facilities were being upgraded. On their return to their villages, one farmer has introduced a moveable shelter and the other has set up a feed garden for his poultry.

In Australia:

Objective 3: Evaluate the nutritional value and palatability of innovative feedstuffs in organic poultry production and communicate information to industry.

In the Australian component of the study at Roseworthy Campus, the organic free-range poultry sector has shown interest in using traditional herbs to overcome some of the poultry health issues that arise in these systems of farming. The objective was to examine whether herbs could be intercropped in a pasture and crop rotation system. However information on palatability and nutritional value of these plants is scant. One trial is complete, showing that meat birds will consume the leaves of the herbs rosemary and thyme when provided as a supplementary forage resource with compound feeds.

PLIA/2005/150: A review of the policy and economic environment in the South Pacific and implications for the adoption of ACIAR project outcomes: a scoping study

Overseas Collaborating Countries Fiji, Kiribati, Samoa, Solomon Islands, Tonga, Vanuatu
Commissioned Organisation Centre for International Economics, Australia
Project Leader Dr Robert Warner
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Collaborating Institutions
Project Budget \$104,800
Project Duration 23/06/2006 to 24/11/2006
ACIAR Research Program Manager Dr Jeff Davis

Project background and objectives

Policy settings in the South Pacific Countries (SPCs) will influence the returns from ACIAR's technical programs and the effectiveness of extension programs. Around 10 per cent of ACIAR's bilateral research and development budget in 2005–06 (around \$2.5 million) was allocated to projects in these SPCs. The primary objective of this scoping study was to identify/characterise the policy and institutional environment in the SPCs that could act to reduce the returns from ACIAR investment in agriculture, forestry and fishery projects. It is an opportunity for ACIAR to complement its technical projects in the Pacific with policy linkage projects of others.

Project progress

First progress report due in 2007.

SFS/2001/036: Maximising the economic benefits to Pacific Island Nations from management of migratory tuna stocks

Overseas Collaborating Countries	Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu
Commissioned Organisation	La Trobe University, School of Economics, Australia
Project Leader	Dr John Kennedy Phone: 03 94792313 Fax: 03 94791654 Email: j.kennedy@latrobe.edu.au
Project Web Site	http://www.business.latrobe.edu.au/staffhp/jkennedy/ACIARTechPapers.htm
Collaborating Institutions	University of Queensland, Australia Secretariat of the Pacific Community, New Caledonia Forum Fisheries Agency, Solomon Islands
Project Budget	\$577,584
Project Duration	01/01/2002 to 31/12/2007 (Project extended from 01/01/2006 to 31/12/2007)
ACIAR Research Program Manager	Dr Simon Hearn

Project background and objectives

Stocks of tuna migrate through the exclusive economic zones (EEZs) of island nations in the Western and Central Pacific Ocean. The migratory nature of the tuna means that no nation has control over tuna stocks. Over the last decade the proportion of Pacific tuna caught by island nations has risen substantially and, at the same time, the level of purse seining by distant water fishing nations has also risen significantly.

A bioeconomic model (developed in an earlier ACIAR project) of the Pacific tuna fishery has been used by the Forum Fisheries Agency and the Secretariat of the Pacific Community to identify and analyse various concerns associated with increased purse seine catching. One of the negative impacts identified is that increased purse seining reduces catch of larger (older) and higher priced tuna caught by longliners and sold fresh. A second concern identified with the model is that the traditional method of charging the purse seine fleets of distant water fishing nations for access to the EEZs of the Western and Central Pacific Ocean is not maximising the flow of annual rents from tuna harvesting to island nations. A third issue is that excess vessel capacity has built up in the fleets that harvest the tuna, which has led to economic inefficiencies in harvesting.

The project is identifying and promoting strategies for Pacific Island Nations to maximise the economic benefits from their migratory tuna stocks. The aim is to determine the economic negotiating positions of Pacific Island Nations (PINs) that have rights to stocks of migratory tuna passing through their economic fishing zones, and the Distant Water Fleet Nations (DWFNs) such as Japan, USA, South Korea, Taiwan and China that are interested in paying for access to the stocks. This relies on interactive modeling of the optimal access offers of the PINs and the optimal harvesting decisions of the DWFNs.

Project progress

Year 4 (01/01/2005–31/12/2005)

The Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific was installed in December 2004, under the auspices of the United Nations Fish Stocks Agreement, which came into force in 2001. The Commission is investigating alternative management measures for ensuring stocks will be effectively managed and that catches will be sustainable. The modelling resources developed in this project will enable estimates to be made of the producer rents flowing to different fishing fleets targeting different tuna species, inside and outside the exclusive economic zones of the PINs, from alternative regulatory measures.

Objective 1: Updating and extending the capability of the bioeconomic tuna model:

Extending modelled fleet coverage

Domestic fleets of the Philippines and Indonesia and the troll fleet targeting albacore operating in the Pacific were added to the model. The range of purse seine fleets was increased from the original four (Japan, Korea, Taiwan and the US) to include fleets for the Pacific Islands, Western and Central Pacific Ocean, and Eastern Pacific Ocean.

Extending the area of modelled fishing effort

Previously the model decision variables were harvesting effort by each fleet within the region covered by the Forum Fisheries Agency (FFA). Fleet harvesting efforts outside the FFA region are now included as decision variables.

Updating biological parameters

Age classes for all four tuna species are by quarter (previously albacore was by year). Natural mortality is specified by quarterly age class, instead of constant across all ages. Changes were instituted to make the harvest function selectivity coefficients dependent only on gear type (purse-seine, pole and line, and longline), instead of on fleet and gear type.

Effort and stock exponents in the harvest functions used in the model had been set at 1.0 following widespread practice. Empirical estimation showed that WCPO purse seine stock exponents for skipjack were better set at 0.7, and for yellowfin at 0.3. Changes have been made accordingly in the updated model.

The match between modelled and observed catches was improved by estimating catchability coefficients for each fleet, this time allowing the coefficients to be different for harvesting effort inside and outside the FFA region. Adjustments have been made to parameters determining recruitment of young fish stock to fisheries in the fishing areas of the Philippines and Indonesia. These were to correct for perceived modelled shortfalls in recruitment in these areas.

Objective 2: Analyse strategic policy options facing the nations of the FFA

The following analysis was conducted with the updated model:

i) Changes in purse seine effort on catch per unit effort (CPUE) and economic rents in the purse seine fishery

The previous model predicted a 10 per cent reduction in fishing effort would increase rents by 55 per cent. The updated model predicted an increase of only 40 per cent.

ii) Effect of an increase in purse seine catchability of yellowfin and bigeye on longline catches and fishery revenue

Repeating tests for increases in purse seine catchability of 50 per cent carried out with the previous model, the updated model confirmed that in the case of yellowfin the overall value of the fishery increased, but decreased for bigeye. The results from the updated model were more pronounced.

iii) Effect of effort reduction across all fisheries on catch and economic rents

Results from the updated model showed that reducing effort level across all fisheries by 30 per cent leads to substantial percentage increases in rents for all fisheries (purse seine, pole and line, frozen longline and fresh longline), inside and outside the FFA region, except in the case of the fresh longline fishery within the FFA region, for which the rent reduction was 2 per cent. Of particular interest is the distribution of gains across the fisheries. The frozen longline fishery gains to a much greater extent than the purse seine, pole and line and fresh longline fisheries.

SFS/2002/047: Trade liberalisation, agriculture and land degradation in Fiji: implications for sustainable development policies

Overseas Collaborating Countries	Fiji
Commissioned Organisation	University of Queensland, Australia
Project Leader	Dr John Asafu-Adjaye Phone: 07 33656539 Fax: 07 33657299 Email: j.asafu-adjaye@economics.uq.edu.au
Collaborating Institutions	University of the South Pacific, Fiji Ministry of Finance and National Planning, Fiji Australian Bureau for Agricultural and Resource Economics, Australia
Project Budget	\$394,677
Project Duration	01/10/2003 to 30/09/2007 (Project extended from 01/10/2006 to 30/09/2007)
ACIAR Research Program Manager	Dr Simon Hearn

Project background and objectives

Export-oriented growth is a key to the sustainable long-term development of the Fijian economy. Much of this growth is expected in the medium-term, to come from agriculture, a sector where Fiji has comparative trade advantages. Agriculture has contributed the bulk of total exports and almost a fifth of GDP, but both these contributions are in decline. Trade liberalisation is driving some agricultural growth and could become an important driver of sustainable development. There is a danger that the impacts of increased production could harm Fiji's fragile ecosystem. Land degradation resulting from cultivation on steep slopes and marginal lands, combined with deforestation on these and other lands, are already causing problems. The availability and quality of freshwater is being affected and biodiversity is being lost. Land and sea-based pollution are also rising.

These are areas of concern for the Government but must be balanced against the potential for trade liberalisation to drive development. Policies are needed to strike this balance and ensure benefits are gained from trade liberalisation while maintaining effective environmental resource conservation measures. Key institutions will be responsible for developing and implementing these policies, but they have little experience in these areas.

The overall goal of the project is to empirically assess the economic and environmental impacts of agricultural trade liberalisation as well as the agricultural production and trade effects of environmental changes, and to propose measures to mitigate any adverse impacts. The specific objectives aimed at supportive policies to enhance sustainable development are to:

- assess the impact of trade liberalisation policies on agricultural production, the economy and the environment, with particular emphasis on land degradation, biodiversity etc.
- critically review the institutional framework required to make trade, environment and agricultural policies more effective as drivers of sustainable development.
- collaborate with and build USP and National Planning Office (NPO) staff capacity in economics research, with particular reference to trade policy analysis and environment-economy modelling.
- communicate the findings to the stakeholders and the academic community through technical and non-technical publications. Model the effects of climate change on agricultural output and the economy.

Project progress

Year 3 (01/10/2005–30/09/2006)

Project activities were delayed at the commencement date due to the late signing of the MOU the parties. Consequently, there has been a lag in project activities. Nevertheless, progress has been made and is briefly summarised below.

(i) Assess the impact of trade liberalisation on the economy and the environment, with particular emphasis on effects on land degradation, biodiversity

Work was completed in updating the Fiji CGE model to a 2002 base year. The activities included incorporating land as a factor of production and balancing the input-output tables. The model was tested and evaluated to ensure that it is consistent and reliable. Simulation experiments were conducted with the model and the results were analysed and documented. Data already collected for the environmental module were also analysed and written up. However, work is continuing to modify the CGE model to account for environmental effects, and to test the environment-economy model.

(ii) Critically review the institutional framework required to make trade, environment, and agricultural policies more effective as drivers of sustainable development

Early in the project the co-leader produced a review paper on Fiji's WTO negotiations and implications for the environment. Consultations are yet to be held with the stakeholders, which is a necessary prerequisite to developing a set of policy guidelines to integrate environmental issues into Fiji's trade policies.

(iii) Collaborate with and build Partner Country staff capacity in economics research

Scheduled training workshops for this year have been postponed to next year due to the delays alluded to earlier and also a job change for a key project staff member. The project's research officer, based in Fiji, registered for a PhD and is now spending one year of full-time studies at the University of Queensland under the supervision of the Queensland-based collaborators. He is funded by the University of the South Pacific. Another Fijian project collaborator won a John Allwright Fellowship and is now pursuing an M.Phil at the University of Queensland.

(iv) Communicate the findings to the stakeholders and academic community through technical and non-technical publications

The project leader presented the results of analyses conducted so far at two international conferences—the 50th Australian Agricultural and Resource Economics Society conference held in February 2006 in Sydney, and the 61st International Atlantic Economic Society conference held in March 2006, in Berlin. The Project Working Papers presented at these conferences have been submitted to high-impact factor journals and one of them is currently at the 'revise and resubmit' stage. Plans are also afoot to establish a website to make publicly available these papers and other project publications.

SFS/2003/069: Policy options for improving the value of land use in smallholder Fijian agriculture

Overseas Collaborating Countries	Fiji
Commissioned Organisation	Deakin University, School of Accounting, Economics and Finance, Australia
Project Leader	Dr Phillip Hone Phone: 03 9244 6530 Fax: 03 9808 9497 Email: hone@deakin.edu.au
Collaborating Institutions	Ministry of Agriculture, Sugar and Land Resettlement, Fiji Secretariat of the Pacific Community, Fiji
Project Budget	\$722,445
Project Duration	01/07/2005 to 30/06/2008
ACIAR Research Program Manager	Dr Simon Hearn

Project background and objectives

Appropriate policy interventions need decision-makers who are up-to-date on relevant information. Analytical tools to support policy-making are also vital. In the case of food, agriculture and natural resource management inappropriate policies can be detrimental to supporting agricultural development and its important role in broader economic growth.

Fiji is a resource-rich country, poor in terms of economic growth. The climate, considerable areas of good soils and arable land and rich marine and forest resources should ensure high levels of agricultural productivity. Although the workforce is relatively small it is highly skilled. All of these factors, combined with tourism as an ongoing contributor, should combine to result in good economic growth, rather than the poor performances characteristic of the last 15 years, when real economic growth in Fiji has averaged 2.6 per cent a year.

Agriculture as a sector is vital to improving this overall performance, accounting for 22 per cent of total official GDP, but much beyond this is uncertain. The percentage agriculture contributes to the real economy and the numbers it employs are unknown. This level of uncertainty spreads beyond overall impacts with levels of production from smallholders to subsistence farmers and land-use patterns and trends also being largely unknown. There are significant challenges relating to land tenure, particularly in the sugar industry as a result of reforms, and little information relating to the impacts of production on poor dietary nutrition and increasing obesity levels. Therefore appropriate policy interventions are needed, based on sound and accurate information.

The aim of this project is to guide policy intervention in the agricultural sector in order to improve the overall efficiency of the agri-food policy system. This broad aim will be achieved through:

- a measuring and forecasting system of smallholder production, consumption and sales;
- understanding price elasticities of major foods;
- a market-based model for policy simulations.

Project progress

Year 1 (01/07/2005–30/06/2006)

The project was formally approved on 1 August 2005. The initial administrative tasks involved formalising the research team and establishing lines of accountability and financial control between Deakin and project staff within the Ministry of Agriculture in Suva (MA) and the Secretariat of the Pacific Community.

We have:

- established a good working team with members from Deakin, the MA, the Fiji Islands Bureau of Statistics and the Secretariat of the Pacific Community;
- appointed a project officer within the MA;
- introduced financial systems to ensure the smooth flow of funds from Deakin to our counterparts in Fiji and Noumea and acquittal mechanisms to ensure accountability.

A project planning seminar held in Suva brought together interested parties from the groups formally associated with the project plus staff from the University of the South Pacific, AusAID and The Ministry of Planning—and importantly the Fiji Islands Bureau of Statistics.

Research

Sound progress has been made by the project team. The initial tasks related to **Objective 1**, and involved: refining the research plan; developing a detailed primary data collection plan; undertaking a comprehensive overview of the existing agricultural systems in Fiji; reviewing the policy environment in Fiji; reviewing data reliability; familiarisation of the Fiji team with different policy evaluation approaches.

The planning of the primary data collection has involved the development of a set of questionnaires for use in the surveys. In doing so we trialled alternative ways of eliciting estimates of production and consumption from smallholders. This led to the development of two comprehensive surveys that address issues not adequately tested in the past. The production survey focuses on measuring producer responsiveness to output price changes as well as measuring input and output information. The consumer survey will provide estimates of household responsiveness to food price changes. These surveys will be considered by the Deakin Ethics Committee as the next stage in this process.

The study of the existing data sources involved extensive consultation with staff from The Bureau of Statistics in Suva and the MA. As a result of these consultations a system has been established for leveraging our survey work on that already undertaken by the MA and the Bureau of Stats. This review procedure highlighted issues associated with the existing data collection processes in Fiji. For example, the estimates of the value of Agricultural GDP have been critically analysed. As part of this analysis apparent inconsistencies with the current procedure were identified and a set of alternative estimates were derived. These estimates were published in a conference paper, a version which paper will be published with the papers from the Conference on Governance and Accountability in the Pacific.

As part of the review of the agricultural systems and existing data sources a paper was prepared on the structure and vulnerability of smallholder agricultural systems to shocks. This paper was presented at the 2006 Annual Conference of the Australian Agricultural and Resource Economics Society. A related paper was submitted to the *Journal of Pacific Studies*. This paper highlighted the dual nature of the smallholder agricultural system in Fiji. The Indo-Fijian and Fijian smallholders operate very different agricultural systems and have very different interactions with the commercial sector. While the members of both groups are heavily involved with the commercial sector, the nature of this involvement means that the impact of market shocks such as the sugar price regime change will have very different impacts on these two groups. This is a finding of importance in the formulation of adjustment policy.

Data availability

A major success has been obtaining the agreement of the Fiji Islands Bureau of Statistics (FIBoS) to the use of data from their *Household Income and Expenditure Survey 2002–2003* (HIES) in the project. The HIES data will provide the sampling frame for both the urban and rural surveys so the project will have the benefit of a recent and full enumeration of urban and rural households to work from. In addition FIBoS have (very generously) agreed to the 'importation' of their unit record data into the unit record sets for the project surveys. This means that our consumer survey can now include a food expenditure diary (more accurate than recall). Once the survey is complete we should be able to construct a cross section/time series data set that should provide a back-up to the principal, i.e. survey means of deriving the consumer demand elasticities required for the project.

SFS/2005/140: Participatory needs assessment for capacity building in extension (Pacific Islands)

Overseas Collaborating Countries	Fiji, South Pacific general
Commissioned Organisation	University of Queensland, School of Natural and Rural Systems Management, Australia
Project Leader	Dr Christine King Phone: 07 5460 1105 Fax: 07 5460 1324 Email: Christine.king@uq.edu.au
Collaborating Institutions	Secretariat of the Pacific Community, Development of Sustainable Agriculture in the Pacific, Fiji University of the South Pacific, School of Agriculture and Food Technology, Fiji
Project Budget	\$77,600
Project Duration	01/07/2006 to 31/12/2007
ACIAR Research Program Manager	Dr Simon Hearn

Project background and objectives

One of the key priorities emerging from the Pacific Extension Summit hosted by Tonga in November 2005 was the need to build the capacity of extension staff and associated institutions to undertake participatory research and extension (PARE). In support of the process this project will conduct a participatory needs assessment. It will study a range of Pacific islands and different institutions, to account for variations in context (e.g. social and cultural differences, previous institutional experiences, farmers needs) and differences in institutional roles (e.g. of tertiary institutions, NGO networking agencies, government extension and research staff).

Project progress

First progress report due in 2007.

SMCN/1998/028: Diagnosis and correction of nutritional disorders of yams

Overseas Collaborating Countries	Papua New Guinea, Tonga, Vanuatu
Commissioned Organisation	University of Queensland, The School of Land and Food Sciences, Australia
Project Leader	Dr Jane O'Sullivan Phone: 07 33654811 Fax: 07 33651188 Email: j.osullivan@mailbox.uq.edu.au
Collaborating Institutions	Ministry of Agriculture and Forestry, Tonga Department of Agriculture Livestock and Horticulture, Vanuatu National Agricultural Research Institute, Papua New Guinea
Project Budget	\$1,101,049
Project Duration	01/07/1999 to 31/12/2006 (Project extended from 01/08/2005 to 31/12/2006)
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

Yams are staple foodstuffs in many developing tropical countries. Along with their importance in the diet, they also have great cultural significance in many Pacific nations. In addition, they provide income for semi-subsistence farmers, and export revenue for some countries. In 1995 the Pacific crop was around 288 000 tonnes (around 42 kg per capita), making it the Pacific's third most important food crop. However, yam production in many Pacific nations has been falling, as intensified farming of other crops has taken over from smallholder production. Imported foodstuffs, often less nutritious than yams but cheaper, are starting to replace yams in the diet. This has serious health implications for the population.

There is still a preference for yams among the islanders, but consumers find the prices too high compared with imported foodstuffs, while farmers are discouraged from growing more than their own needs by a feeling that the prices are too low for what is a labour-intensive crop. Part of the reason for the rather high cost of yam production is the low yields obtained by farmers for the effort invested. This is caused mainly by soil nutrient deficiencies that are reducing both growth and tuber production by the plants. This project is providing information to help in the diagnosis of nutritional disorders affecting yam plants, prior to developing feasible options for improving crop nutrition in affected areas.

Project progress

Year 7 (01/07/2005–30/06/2006)

Marie Melteras (Vanuatu project research officer and John Allwright Fellow) submitted her Masters of Philosophy thesis in July 2005 before returning to Vanuatu. The title of the thesis is 'Soil fertility as a factor affecting the production of yams (*Dioscorea* spp.) in Vanuatu'. The thesis examiners' reports were received in November, recommending a number of minor changes. These were completed and the revised thesis submitted in July 2006.

Dr. O'Sullivan completed work as contracted on the PNG project reports in July 2005. In September, she attended the 13th International Plant Nutrition Colloquium in Beijing, with support from the Plant Nutrition Trust (Alf Anderson Award). She presented a poster entitled *Interpretation of tissue analysis for potassium nutrition in tropical root crops dependent on sodium concentration* describing work resulting from the Masters program of Sharryl Ivahupa, a John Allwright Fellow under ACIAR LWR2/1991/01. A more detailed account of this work was published in the Journal of Plant Nutrition in June 2006 (Volume 29(6), 1095–1108).

September also saw the completion and publication of the internet and CD resource *Sweetpotato DiagNotes*, the product of ACIAR SMCN/2000/060. The product has been widely acclaimed. The internet version is available at <http://www.lucidcentral.org/keys/sweetpotato>.

A paper on nutritional deficiencies of *Dioscorea alata* was accepted for publication by the *Journal of Plant Nutrition*, and will include two colour plates containing 23 images of deficiency symptoms. The cost of publishing the colour plates was covered by ACIAR in the current extension budget.

Manuscripts of three papers resulting from the project were drafted in October–December 2005 and circulated for co-author comment. These have since been submitted for publication. Of the work identified to be completed in the 2006 extension period:

- the slide collection of symptoms of nutritional disorders in yams (1600 slides) has been scanned at high resolution to a digital database. This is yet to be annotated.
- the leaf analysis samples identified as requiring re-analysis have been rerun, completing the primary data from the project.

Work remaining includes completion of data analysis and compilation of results.

SMCN/2001/038: Management of animal waste to improve the productivity of Pacific farming systems

Overseas Collaborating Countries	Fiji, Kiribati, Tonga, Tuvalu
Commissioned Organisation	University of Western Sydney, School of Environment and Agriculture, Australia
Project Leader	Dr Gavin Ramsay Phone: 02 4570 1282 Fax: 02 4570 1750 Email: g.ramsay@uws.edu.au
Collaborating Institutions	Secretariat of the Pacific Community, Fiji Foundation of the People's of the South Pacific International, Fiji
Project Budget	\$381,340
Project Duration	01/07/2002 to 31/03/2007 (Project extended from 01/01/2006 to 31/03/2007)
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

Livestock play an important role in the cultures of Pacific island countries. Most animals used to be free ranging. However, livestock numbers have increased to the point where public pressure has forced many owners to tether them or keep them in pens. As a result, waste is concentrated in and around specific areas. Most waste is not collected or managed; rather, it is left where it lies. This contaminates surface and underground water, leading to human health risks and the loss of potential agricultural and economic gains.

Animal manure can be used to produce methane and fertiliser for village crops and gardens. However, time and effort are often required to maintain the equipment needed to do this, and many communities have been unwilling to adopt new practices they do not understand. There is a need for better information on how animal manure can be used more productively in Pacific island countries and on the relevant attitudes and values of local people.

The aim of this project is to help Pacific island countries to use animal waste productively rather than allowing it to pollute water supplies to the detriment of human health.

Project progress

Year 3 (01/07/2004–30/06/2005)

Considerable progress has been made in the last 12 months towards meeting project objectives. The project has continued the consultation with communities and, in partnership with the communities, has moved to an implementation phase in which new piggeries with alternative waste management systems are being constructed. New piggeries were constructed in Fiji, construction commenced in Tonga and an existing piggery was renovated for demonstration purposes in Tuvalu.

One new piggery was constructed in Votua Village on the Coral Coast of Vitu Levu, Fiji. The area has an increasing human population due to the growth of the tourism industry. This had led to an increased number of pigs and therefore higher risk of water contamination from pig waste. The new piggery is built away from water sources and is a simple construction that could be copied elsewhere. Further work has been carried out at one village in Fiji with an emphasis on the catchment above the village. Several sources of faecal pollution have been identified and are being investigated. It has been found that while the village had reticulated water that the small dam and reservoir were insufficient to meet the needs of the community and therefore contaminated water from the creek adjacent to the village was still the main source of water to the community. Water monitoring has been carried out monthly for over three years and good quality data are available to show the environmental and health risks of contaminated water.

Two new piggeries are being constructed in Ahua, Tonga and will be used as demonstration sites. This project aligns with and will provide information to support the AusAID project on total solid waste management in Tonga. The Tongan Agriculture Department, one of the project partners, is working with the Ministry of Forestry in Tonga and the Tonga Trust (an NGO)—both of which are working on solid waste management.

The project has generated support and interest from the UNDP/GEF International Waters Project that has similar aims and activities in several Pacific Island countries. An agreement was developed to share information between the projects and provide support where relevant.

A consultant in Fiji was employed to assess the success of participation in the project in the two villages that were contacted at the beginning of the project. A report was produced that gave good insights into dealing with waste management and working with communities in Fiji. The objectives of the consultancy were:

1. to assess the understanding of and response to the intervention by the community;
2. to analyse the factors that may have contributed to the acceptance of the project in Votua and its rejection in Komave;
3. to consider the knowledge and view that the community has of other projects/institutions operating in the area;
4. to provide recommendations on how waste management community process may be improved in future and a checklist of those factors that may hinder and those that may promote community collaboration.

A major study has been conducted on the importance of pigs in Pacific culture, filling a large gap in the documented knowledge. This study brought together information on the historical links between pigs and people and provides insights into the attitudes of people towards pigs and the customs of raising pigs and using them for ceremonies.

FIS/2003/051: Improving sustainability and profitability of village sea cucumber fisheries in Solomon Islands

Overseas Collaborating Countries	Solomon Islands
Commissioned Organisation	WorldFish Center, New Caledonia
Project Leader	Dr Warwick Nash Phone: 687 262000 Fax: 687 263818 Email: w.nash@cgiar.org
Collaborating Institutions	Department of Fisheries and Marine Resources, Solomon Islands WorldFish Center, Solomon Islands
Project Budget	\$400,000
Project Duration	01/01/2005 to 31/12/2008
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Marine resources are important industries in the Solomon Islands. Tuna and sea cucumber (bêche-de-mer) fisheries contribute the most value to the Solomon's economy; both worth millions of dollars annually. Sea cucumbers have been a valuable export commodity, with the export price rising in recent years, at a time when other commodity prices are falling. Another important aspect of utilising marine resources is food and income for smallholders in coastal communities. Sea cucumber harvesting, usually conducted at the village level, creates significant income flows that stream throughout villages and nearby communities. Recent civil unrest has limited the opportunities available to villagers to earn income. One consequence of this has been increased harvesting of sea cucumber.

Increased harvests in the early 1990s, a time of economic hardship, led to a sharp rise in catches that soon proved unsustainable. Soon after, harvests declined dramatically. Numbers of sea cucumber have gradually risen but with economic hardship again prevalent following civil unrest many coastal communities are again increasing harvests, threatening a collapse of fisheries. This would be the worst possible result given that income streams would dry up. Sustainable management is needed to ensure that coastal communities can continue to utilise this vital resources without compromising its long-term value.

The project aims to facilitate this through sound community-based management of the sea cucumber fishery, working in collaboration with the national Department of Fisheries and Marine Resources and the Provincial governments, also to ensure incomes are available to fishers for the bêche-de-mer that they produce. These objectives will be achieved by:

- working with selected communities to develop sustainable, community-based sea cucumber fisheries and produce high-quality bêche-de-mer;
- assisting communities to obtain improved returns for their bêche-de-mer product.

Project progress

Year 1 (01/01/2005–31/12/2005)

Progress was made in 2005 with the following activities conducted:

- A project implementation workshop was held over 3 days in Honiara in April 2005. Twenty people participated in the workshop, in addition to the ACIAR project team. Participants included representatives from Kia community (first project site, Isabel Province), Minister for Natural Resources—Isabel Province, Provincial Senior Fisheries Officer—Isabel Province, UNDP—Isabel Province Development Program, the Department of Fisheries and Marine Resources (DFMR), the International Waters Program, the Foundation of the Peoples of the South Pacific International (FSPI) and The Nature Conservancy (TNC).
- In May/June 2005 the project team undertook the first project visit to Kia to conduct village surveys using a questionnaire approach. The surveys covered all 159 households in the community. The four components of the survey were: (i) household socioeconomic conditions; (ii) community utilisation and perceptions of the sea cucumber fishery; (iii) community business operations and development; (iv) community leadership and governance. Until the ban on sea cucumber fishing in December (see below), there was a high reliance on the *bêche-de-mer* fishery for income in Kia. Trends in the catch over time (fishing location, species harvested, catch rates, fishing methods) gave clear evidence of population declines, probably caused directly by fishing. Despite this, little or no effort was being made to modify fishing habits to reduce fishing pressure.
- Discussions on sea cucumber stock assessment, the use of the traditional *tambu* system of rotational closures as a component of fishery management measures, and the creation of a community *Bêche-de-mer* Project Management Committee were also initiated during the May/June trip in preparation for the next visit in August. The August trip didn't eventuate as, shortly after the May/June survey was conducted, a ban on the export of *bêche-de-mer* was announced by the DFMR. The ban, the events leading up to it, and future plans for the fishery and its management are described by Nash and Ramofafia (in press). The ban was put into effect on 1 December. This necessitated a realignment of project objectives because the community was reluctant to engage in discussions of management options for the fishery, or to develop a community fishery management plan, for a resource they could no longer fish. As well, there was no fishing activity to which planned field activities could be linked. Importantly, there was a widespread misconception in Kia that the ban was introduced because of information given by Kia community members to the project team during the first survey. It was therefore necessary to reschedule project objectives and to engage with the community in various ways to regain their trust.

The project team conducted three visits to Isabel Province—one to Buala (the Provincial capital) and two to Kia. Meetings and discussions were held with Kia leaders during the Buala trip (June 2005). In addition, there was extensive public discussion and extensive awareness-raising in the Isabel Province community of the national fishing ban and its justification (the visit coincided with a week-long Provincial Trade Show). The Kia visits were undertaken in September and November 2005. The September trip: i) clarified to the community the project team's involvement with the ban, in order to remove community misconceptions; ii) assessed in more detail, through further surveys, the impacts of the impending national *bêche-de-mer* ban on the community; iii) provided insights into community organisation, governance and leadership through meetings with community members; iv) gave training on participatory community management. Activities (iii) and (iv) continued during the November trip.

HORT/2005/134: The use of pathogen-tested planting materials to improve sustainable sweet potato production in Solomon Islands and Papua New Guinea

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	International Potato Center, East and Southeast Asia and the Pacific Regional Office, Indonesia
Project Leader	Dr Fernando Ezeta Phone: 62 251 317951 Fax: 62 251 316264 Email: f.ezeta@cgiar.org
Collaborating Institutions	Queensland Department of Primary Industries and Fisheries, Australia National Agricultural Research Institute, Papua New Guinea Department of Agriculture and Livestock, Solomon Islands Kastom Gaden Association, Solomon Islands
Project Budget	\$800,000
Project Duration	01/09/2006 to 31/08/2010
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

In Papua New Guinea and Solomon Islands yield decline has been recorded in sweet potato varieties over time. Introducing and adapting technologies that produce consistently high-yielding and nutritious crops of sweet potato can help to satisfy household consumption, improve human nutrition and supply domestic markets. A key to achieving high productivity and nutritious tuberous roots of sweet potato is the use of healthy cuttings (termed 'seed') and cultural practices which promote plant vigour and reduced pests and diseases. However, as a prerequisite, there is need to understand the seed supply system. How do farmers retain planting material from crop to crop or obtain new cultivars as those presently grown decline?

The project will investigate these aspects in both countries. Pathogen-tested material will be introduced and tested using extension practices perfected by the International Potato Center (CIP) in Asian countries. Project work will involve national research and extension institutions, non-government organisations, community-based organisations and lead farmers.

Most project activities will be implemented in Solomon Islands (SI) for two reasons: first, recent reviews have shown an urgent need to deal with falling crop yields in areas of high cropping intensity resulting from rapid population increase; second, some work of a similar nature focusing on the highlands has commenced in Papua New Guinea (PNG) during ACIAR project CP/2004/071, therefore this project will focus mainly on the PNG lowlands.

Project objectives are to describe and evaluate sweet potato seed supply systems in Papua New Guinea and Solomon Islands, to introduce and evaluate improved varieties, and to introduce, refine and disseminate technologies for improved supply systems of sweet potato seed for smallholders practising low-input agriculture.

Project progress

First progress report due in 2007.

SFS/2001/068: Technical support for regional plant genetic resources development in the Pacific

Overseas Collaborating Countries	Fiji, Kiribati, Malaysia, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu
Commissioned Organisation	International Plant Genetic Resources Institute, Malaysia
Project Leader	Dr V. Ramanatha Rao Phone: +60 3 89423891 Fax: +60 3 89487655 Email: v.rao@cgiar.org
Collaborating Institutions	Secretariat of the Pacific Community, Fiji
Project Budget	\$933,797
Project Duration	01/01/2002 to 31/12/2006 (Project extended from 01/01/2005 to 31/12/2006)
ACIAR Research Program Manager	Dr Simon Hearn

Project background and objectives

The unique and important diversity maintained in the perennial crop-based production systems of Pacific Island countries is becoming better recognised. In the context of agricultural plant genetic resources (PGR) conservation and use, some collecting, conservation and improvement of PGR (e.g. roots and tubers, bananas, coconuts and breadfruit) has been carried out in the region. This includes the establishment of the Regional Germplasm Centre (RGC) at the Secretariat of the Pacific Community (SPC) and activities funded by the European Union (the EU-funded Pacific Regional Agricultural Programme (PRAP)), INIBAP (the International Network for the Improvement of Banana and Plantain—one of IPGRI's programs), Australia's Department Agriculture, forestry and Fisheries through SPC, and COGENT (the International Coconut Genetic Resources Network, for which IPGRI provides the facilitation unit). More recent and current PGR activities in the region include: the AusAID-funded TaroGen project for the improvement, conservation and utilisation of taro genetic resources; the EU-funded South Pacific Yam Network (SPYN) for collecting and conservation of *Dioscorea alata*; COGENT activities focusing on the collecting of coconut populations from Pacific Island countries and their establishment in the PNG International Coconut Genebank; further breadfruit characterisation; and distribution of INIBAP banana lines resistant to Black Leaf Streak virus.

However, it has been observed that progress has so far been made only with a few crops in a limited number of countries. In view of this, in April 1999, ACIAR supported a workshop in Lae, Papua New Guinea (PNG) in order to develop a framework for PGR conservation, management and use in Pacific agriculture. Following this a PGR Working Group was established, consisting of PNG and Fiji, facilitated by SPC. The working group came together and developed the regional plant genetic resources framework for the Pacific, which was approved by the Permanent Heads of Agricultural and Livestock Services (PHALPS) during its meeting in Fiji in early 2001.

The project is developing complementary conservation strategies (CCS) for agricultural crops of importance in the Pacific Region as a basis for sustainable plant genetic resource (PGR) conservation; including guidelines for the implementation of CCS, and promoting their implementation for high-priority agricultural crops.

Project progress

Year 4 (01/01/2005–31/12/2005)

Ensure effective coordination of PGR activities at regional level in the Pacific

Continued regional coordination and collaboration on PGR issues is essential in the Pacific, where national capacity and resources remain limited and these must therefore be used as efficiently as possible. The Pacific Agricultural Plant Genetic Resources Network (PAPGREN) annual meeting took place in Vanuatu in October 2005, allowing network members to visit the Vanuatu Agricultural Research and Training Centre, where interesting PGR conservation and breeding work is taking place. A major output of the meeting was an agreement on the major points of a regional strategy for the Global Crop Diversity Trust.

The RGC Adviser attended the Banana Asia-Pacific Network (BAPNET) annual meeting. The PGR Adviser attended the annual COGENT meeting, the International Coconut Forum and participated, on behalf of the region, in a meeting at IPGRI, aimed at developing a global project on monitoring genetic erosion. The email alert service PGR News from the Pacific continues to provide information to PGR stakeholders in the Pacific and beyond.

Develop and implement strategies for the effective conservation and use of PGR for food and agriculture in the Pacific (including neglected and underutilised species)

PAPGREN meetings in 2004 and 2005 agreed on the elements of a regional strategy for ex situ conservation, which formed the basis of a submission to the Global Crop Diversity Trust (GCDT) in January 2006. This strategy is based on complementarity of approaches (field genebanks, tissue culture, and cryopreservation), adequate duplication, and effective collaboration among all stakeholders within the region and beyond as necessary. It includes elements of the strategy for taro and breadfruit developed by TaroGen and PAPGREN, thus building on earlier efforts by this project's precursors. Pacific regional strategies for banana and coconut have also been developed for the GCDT with substantial input from the RGC and PGR Advisers in consultation with national programme focal points. A concept note for a Pacific Regional Crop Improvement (PARCIP) programme has been finalised. Specific targeted activities have been supported in participating countries to strengthen conservation of priority PGR:

Bele in Vanuatu. There are two mature core collections in Santo. Peter Kaoh and Oniel (DSAP), Tan Molisale and two students, under DSAP Vanuatu, have been describing the two collections using the NARI descriptor list. In February a larger collection was established at VARTC combining plants from both collections. Peter Kaoh recently flew to Vila with planting materials from the two Santo collections. Plantings are now under way in Tagabe plot—a collaboration with other SPC Teams and projects.

Taveuni taro genebank, Fiji. It was agreed to have the Taveuni Taro Genebank established as an activity in the 'Keep Taveuni Taro Beetle Free' campaign. During the analysis of how the taro beetle could get to Taveuni, stakeholders identified smuggling of varieties from affected areas to Taveuni (an island free of taro beetle) and other non-affected areas as one of the main risk factors. The rationale then was to collect and set up a taro genebank on Taveuni so that farmers would be provided with clean planting materials of the preferred local varieties. These local cultivars are now difficult to find on Taveuni due to the cultivation of the few commercial varieties. Farmers have expressed their keen interest in replanting these local varieties for food security and for meeting traditional obligations such as weddings, funerals etc. About a dozen varieties are currently included in the, locally collected, genebank. Others will be introduced as tissue culture from Koronivia and/or the RGC. This work is a collaboration with other SPC Teams and projects.

Yam genebank in Samoa. The yam collection established and being maintained on-farm by Bill Cable has been characterised using standard descriptor lists (and photographs). A draft catalogue was produced. This work is a collaboration with other SPC Teams and projects.

Genebanks in Kiribati. Genebanks of major traditional crops (breadfruit, pandanus, giant swamp taro) are being established on some outer islands (Araruk, Butaritari, Maraki and Nikunau) to increase access by farmers. This work is also a collaboration with other SPC Teams and projects.

Survey of nut genebanks in Solomon Islands. As a joint SPRIG-SPC-PAPGREN activity, Barry Evans, together with Michael Max of the Department of Agriculture, surveyed the indigenous nut collections he assembled in the 1990s in various research stations in the Solomon Islands. In February 2006, he submitted his draft report summarising the status of the collections and setting out recommendations for their future management. A database of the information on individual trees he collected on this occasion is being put together with older data retrieved from files (many of the original files were destroyed in the Solomon Islands during the recent ethnic tension).

Increase capacity in PGR conservation and use in the Pacific

An important role of the PGR Adviser is to provide training to national staff on PGR issues. This was done during the PAPGREN meeting, where a lengthy session was devoted to the policy issues arising from the ITPGRFA negotiations. The RGC and PGR Advisers also provided lectures and other support to USP's Biodiversity and Conservation course. In addition, the PGR Adviser was a resource person at a meeting of the Agricultural Liaison Officers in Vanuatu in August, which served to heighten the awareness of PGR issues of these key information people. Two people, one from Koronivia Research Station, Fiji and one from NARI, PNG, attended a training course aimed at promoting the use of the LUCID (a software developed by the Centre for Biological Information Technology for interactive identification). It can be used to distinguish species, disease symptoms or varieties of a crop. This software is expected to be extremely useful for managing and analysing PGR characterisation data.

Concluded projects

at 30 June 2006

Bilateral

ADP/1996/136	Fiji sugar industry: assessing international sugar market reforms and their impacts and defining appropriate responses	78
FIS/2005/026	SPC support for ACIAR seaweed marketing consultancy	80
FIS/2005/029	Marketing options and opportunities for seaweed in the Pacific	82
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Multilateral

FIS/1999/025	Optimal release strategies for restocking and stock enhancement of the tropical sea cucumber, sandfish (<i>Holothuria scabra</i>)	88
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ADP/1996/136: Fiji sugar industry: assessing international sugar market reforms and their impacts and defining appropriate responses

Overseas Collaborating Countries	Fiji
Commissioned Organisation	Australian National University, National Centre for Development Studies, Australia
Project Leader	Dr Padma Lal Phone: +679 3220329 Fax: +679 3300192 Email: padmal@forumsec.org.fj
Collaborating Institutions	University of the South Pacific, Fiji Sugar Commission of Fiji, Fiji Fiji Land Information Council, Fiji CSIRO Tropical Agriculture, Australia Ministry of Planning, Fiji Ministry of Agriculture, Fisheries and Forestry, Fiji
Project Budget	\$806,781
Project Duration	01/01/2000 to 30/09/2005 (Project extended from 01/01/2005 to 30/09/2005)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

The sugar industry in Fiji accounts for about 40 per cent of the value of agricultural production, and 22 per cent of the country's entire GDP. Sugar is also Fiji's largest export earner and a major employer, providing work for about one quarter of the country's active workforce. Fiji has negotiated preferential arrangements with importers of its sugar, guaranteeing quotas at agreed prices. In 1997, about 56 per cent of the country's total sugar production was sold in this way. It is expected that preferential access for Fijian sugar to US and European Union markets will be lost as these nations review their agricultural policies. This will expose Fiji to international competition in the world sugar market where prices have been about half of those that Fiji sugar was enjoying under the preferential agreements. This is likely to have serious effects on the local industry and on the entire country's economy.

Fiji therefore needs to identify options that could help farmers adjust to the likely long-term loss of preferential access. But doing so is not possible without the relevant information and data. Once gathered, these will also form a useful basis for necessary policy reform. It is clear that the sugarcane farming system must adjust to remain viable.

The project set out to provide the government, the sugar industry and the farmers with a range of options to help them effect the necessary changes, by:

- assessing the economic viability of sugarcane-based farming systems under current and alternative sugar price scenarios;
- assessing the financial and economic implications of various land tenure options proposed in Fiji;
- evaluating the economic merit and sharing of the industry profits of the current and the proposed industry restructure and identifying appropriate institutions—including facilitated markets—that could encourage economic efficiency in the sugar industry.

Project outcomes

Originally the project was conceived as an integrated international trade, bioeconomic and institutional framework. However, following the political events of May 2000 the project was resurrected in 2002 with a revised set of project objectives. The scope of the project was reduced, removing international trade, a land use suitability assessment, and alternative land use options and crop modelling, and the CGE modelling) components of the project.

Given the changed priorities in Fiji and the need to focus on the sugar production and land tenure issues, the objects of the revised project were to:

1. assess the financial and bioeconomic viability of sugar cane based farming systems under current and alternative sugar price scenarios;
2. assess the financial and economic implications from the perspectives of the growers, landowners and the sector of various land lease options proposed in Fiji
3. evaluate the economic merit and sharing of the industry profits of the current and the proposed industry restructure and identify appropriate institutions, including facilitated markets, that could encourage economic efficiency in the sugar industry

The project was designed using the philosophy of 'adaptive decision-making process' (ADMP) articulated in Lal, P., H. Lim-Applegate, and M. Scoccimarro. 2001. The adaptive decision-making process as a tool for integrated natural resource management focus, attitudes, and approach.

Conservation Ecology 5(2): 11. [online] URL: <http://consecol.org/vol5/iss2/art11>.

The project has:

1. produced several journal articles and reports, some of which are currently being revised for publication, including the farm economic survey.
2. made submissions to the Parliamentary Cabinet Sub-Committee on Sugar, the Parliamentary Select Committee on Sugar, the Parliamentary Select Committee on Land, and to the Government on the Indian Team Mission Report.
3. prepared policy briefs for use by the Fiji Project Leader in the Sugar Restructure Committee.
4. gave several presentations to stakeholders, including the Prime Minister's Office, the Native Land Trust Board, the Sugar Industry (FSC, SIT, FSM, SCGC), to the Indian Mission Team.
5. provided inputs into the preparation of the Fiji Paper for discussion in Brussels and the industry meeting on prioritisation of issues for submission to the LMC.
6. provided analysis of alternative farm productivity, harvest and transportation costs to the LMC's assignment for the Fiji Sugar Industry in preparation for the forthcoming study by the European Commission
7. produced integrated decision-support systems (DSSs) supported by Sugar GIS database—a computer-based database of validated and harmonised and linked system of databases on cadastral (Land Department), native land tenure (NLTB), farmer characteristics (SIT), farmer production statistics (FSC), soils (MASLR). The DSS can be used to determine, for example, the potential impact of changes in the EU sugar prices, changes in farm level productivity, changes in the cost of harvest and transport. The project has also produced an information-based decision-support system that can be used in land rent negotiation.
8. produced newspaper articles, as well as an indepth-TV interview.

FIS/2005/026: SPC support for ACIAR seaweed marketing consultancy

Overseas Collaborating Countries	Fiji, Kiribati, Papua New Guinea, Solomon Islands, Vanuatu
Commissioned Organisation	Secretariat of the Pacific Community, New Caledonia
Project Leader	Mr Ben Ponia Phone: 687 260166 Fax: 687 263818 Email: benp@spc.int
Collaborating Institutions	
Project Budget	\$16,481
Project Duration	01/06/2005 to 31/07/2005
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The aim of project was to identify and evaluate marketing constraints and opportunities for seaweed in selected Pacific Island countries. This included considering options for bilateral cooperation in the marketing and processing of cultivated *Kappaphycus* with aim to improve profitability and sustainability. This may be achieved through establishing national focal points with governments of key countries, effectively communicating project intentions and linkages with key countries, facilitating country consultations with industry players and facilitating regional meetings to analyse reports and formulate regional strategies.

The objectives of the project were as follows.

1. to more clearly identify and evaluate marketing constraints and opportunities for seaweed in selected Pacific Island countries, including consideration of options for regional cooperation in marketing and processing.
2. to examine the production, processing, transportation and marketing options for the cultivated *Kappaphycus* industry in selected countries of the Pacific Community region, with a view to improving profitability and sustainability.

Project outcomes

The countries covered by the study were Fiji, Kiribati, Solomon Islands and Vanuatu. Originally Papua New Guinea was included but that country decided to lower its priority for commencing seaweed farming and withdrew from the project.

This report gives details of the current supply and demand for *Kappaphycus* and the reasons for its positive future potential. As a result of information gathered from country representatives and the visits that followed to the three seaweed-producing countries (Fiji, Kiribati, Solomon Islands) it became apparent that the quantities of seaweed being produced were too small to consider any regional cooperation in marketing and processing. The priority for all countries must be to increase production. Total annual world production of dried *Kappaphycus* is about 220,000 tonnes. Production for the Pacific Islands for 2005 is expected to be about dried 1150 tonnes (0.5% of world production). This would need to increase to at least 5000 t dried (preferably 10,000 t, 5% of world production) before regional cooperation in marketing could be considered. Because of shipping costs between the islands, it would be uneconomic to ship dried seaweed from individual countries to one central island hub for export to buyers. Regional cooperation might be possible—by establishing a regional marketing authority that dealt with all buyers and directed shipments to be sent as required from individual countries direct to buyers.

However even when regional annual production reaches 5000 t, regional cooperation in marketing may not be agreeable to all producing countries. In Kiribati the industry is government controlled, in Fiji the government plans to pass control to the private sector once production is firmly established, in Solomon Islands all marketing is being done by the private sector. Private sector companies that spend time and money developing markets and clients may see little advantage in surrendering their autonomy to a regional organisation. It may depend on market conditions when regional production reaches the suggested 3–5% of world production.

Processing of seaweed within the region was the subject of a study sponsored by Kiribati. The conclusion reached was that a regional annual production of 10,000 t dried of *Kappaphycus* would be necessary to support a plant for the production of semi-refined carrageenan (SRC) and that such a plant must be located in an area where sufficient quantities of water were available (which excluded Kiribati). However since then the SEAPlantNet project has commenced trials into small scale production of SRC chips using minimal quantities of water, at sites near the seaweed-farming areas. [SEAPlantNet, is an initiative of the International Finance Corporation's Program for Eastern Indonesia SME Assistance (IFC-PENSA)]. Development of such a process would allow individual Pacific Island countries to do their own part-processing and export value-added chips, with 25% of the weight and a smaller volume compared to dried seaweed.

When the country reports and country visits showed that regional cooperation in marketing was currently not feasible, it was decided to replace the proposed sub-regional workshop on marketing with one that would promote cooperation in production. This workshop, held in Nadi, Fiji, resulted in useful discussions between farming representatives from four countries, who resolved to continue communication and cooperation on all matters relating to seaweed farming.

FIS/2005/029: Marketing options and opportunities for seaweed in the Pacific

Overseas Collaborating Countries	Fiji, Kiribati, Tonga, Vanuatu
Commissioned Organisation	Consultant, Australia
Project Leader	Dennis McHugh
Collaborating Institutions	
Project Budget	\$28,400
Project Duration	16/02/2005 to 30/09/2005
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Farming of *Kappaphycus* seaweed (*K. alvarezii*) is considered to be one of the most widely applicable forms of aquaculture in the Pacific region. There is large market demand for the carrageen extract from dried seaweed in the food and pharmaceutical industries. The aim of this consultancy was to work in collaboration with SPC to clearly identify and evaluate marketing constraints and opportunities for seaweed and to examine the production, processing, transportation and marketing options for cultivated *Kappaphycus* in the Pacific region. SPC facilitated logistical and technical support for in-country and regional activities.

Project outcomes

As at October 2006 the final report is forthcoming.

FST/2002/010: Domestication and commercialisation of multi-purpose indigenous trees and shrubs for food and other products in Papua New Guinea, the Solomon Islands and Queensland: a feasibility study with special reference to *Canarium* nut

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	James Cook University, School of Tropical Biology, Australia
Project Leader	Professor Roger Leakey Phone: 07 4042 1573 Fax: 07 4042 1319 Email: roger.leakey@jcu.edu.au
Collaborating Institutions	National Agricultural Research Institute, Papua New Guinea Queensland Department of Primary Industries and Fisheries, Australia Macro Agribusiness Consultants Pty Ltd, Australia Michael Davis Consultants, Australia Commodities Export Marketing Authority, Solomon Islands
Project Budget	\$203,606
Project Duration	01/07/2004 to 30/09/2005 (Project extended from 01/07/2005 to 30/09/2005)
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

The indigenous tree nut *Canarium indicum*, known as Galip Nut in PNG and Ngali in the Solomons, is part of human dietary intake in both countries. As a result the species is domestically important for food security, but less so as a potential cash crop. Some attempts have been made to develop, process and market the nut but these have not resulted in widespread cropping.

Domestication of indigenous fruit and nuts is relatively common in many tropical countries. Such species are important for alleviating food insecurity and addressing nutritional deficiencies in dietary intake. They also provide an income opportunity that can help stimulate improvements in livelihoods. Such approaches towards domesticating indigenous species could also work in PNG and Solomon Islands.

In PNG there are 22 species of *Canarium*, seven of which can be found in New Britain Province. Little, however, was known about these species. A feasibility study of agroforestry of Galip/Ngali was needed to determine if barriers to tree domestication existed in PNG and the Solomons and if these accounted for the lack of agroforestry utilising *Canarium* and other suitable tree species. This study focused on existing participatory approaches that had been successful elsewhere in the tropics. The ability of agroforestry of Galip/Ngali to enhance food security and to create income-generating opportunities was also examined.

The main objective was to determine the feasibility of developing a strategy and methodology for the parallel improvement of the food/nutritional security, together with income-generating opportunities of smallholder farmers through the domestication and commercialisation of indigenous fruit and nut species in PNG (East New Britain), SI and Australia. Specific objectives were to:

- determine the attitudes and perceptions of communities towards indigenous fruits and nuts in the household food intake and in land-use in East New Britain Province PNG
- identify the potential opportunities and constraints to domestication and commercialisation of indigenous fruit and nuts in PNG, SI and Queensland
- identify the research and development issues for domestication and commercialisation of indigenous fruits and nuts, including intellectual property rights (IPR) and cultural issues
- enhance the abilities of project staff in methodologies of community survey and interpretation
- inform stakeholders and participants of the outputs and conclusions of the project.

Project outcomes

Although there were differences in the results observed from the three locations surveyed, the findings were fairly similar—despite differences in the population pressures and market access between the locations.

Importance of Galip

The farmers in ENBP ranked Galip as the most important nut tree species for both food and income generation. Pau was ranked second, followed by Aila, Talis and Okari. Other minor nuts were important to some respondents particularly in the Pomio area. A similar trend was seen in the number of farmers growing the different nut species. There was no difference in farmer rankings of the nut species for their importance as a food source or for income generation. Without exception all those interviewed said that they liked eating Galip. The majority liked eating Galip raw but over half also liked it prepared with other foods and 40% said they liked it roasted.

Galip is a multipurpose tree, in addition to the kernels being an important source of food and cash income Galip was also important for timber (including canoe making), firewood and for traditional and medicinal uses. Just about all parts of the tree (including the trunk, bark, nut oil, resin, leaves, young shoots, kernels, fruit flesh, nut shells and roots) are used by some people.

Production

The average farming family generally had access to 5–12 Galip trees, with a few having large numbers (up to 150 trees). The farmers in the Duke of York Islands tended to have more trees than those in the Gazelle and Pomio. The majority of these trees were self planted—only about a third said they had planted them. If farmers had planted Galip the number planted per farmer was generally less than five. The planting was done by all gender groups with a slightly higher involvement of men. There was very little movement of Galip germplasm from outside individual villages. Only one person had planted material from outside their own district and 20% said they planted materials obtained from outside their own village. The rest of the farmers said they obtained the planting materials from trees within their village.

Up to five Galip types were identified by individuals, with the majority recognising two or three types. Although a large number of local Galip names were given, there were generally two or three major ones at each location surveyed. The main distinguishing features for the different Galip types were the colour of the fruit around the nut shell, the shell colour, the ease of cracking the shell and the nut shape and size.

Most farmers said they had Galip types they preferred over others—taste, kernel size and ease of cracking and kernel oiliness were the main reasons given for the preference. One third of the respondents said they had no problems with growing Galip. For others, lack of knowledge, land availability, irregularity of fruiting and lack of planting materials constituted the main problems.

Nearly all the farmers interviewed indicated a desire to grow more nut trees than they currently do with Galip and Pau the preferred species. The reasons given for wanting to grow more Galip was for income followed by food and then traditional ceremonies. The reasons for wanting to grow more Pau related more to the nature of the Pau, a smaller backyard tree that starts bearing at a young age and has a non seasonal production.

Seasonality

Although the data were not very clear it appears that the fruiting period may vary in different locations of ENBP. This would be an advantage for improving continuity of supply if correct. Further work is required—to accurately determine the fruiting patterns of Galip in the different locations and establish the factors affecting the timing of the main production periods.

Post-harvest

The Galip is generally harvested equally by all gender groups. The main method of harvesting is to collect fallen nuts from the ground, however climbing the trees to harvest and cutting the fruit-bearing branches down are also important methods, particularly in Pomio. The maturity of the fruit is determined by the skin colour change from green to dark purple or black (or dark maroon in some cultivars) or when they start to fall from the tree. The main problems farmers had with harvesting the Galip nuts was trees that were too big and dangerous to climb to harvest the fruit, stealing, and the fruit being eaten by animals (flying foxes and pigs).

The methods of removing the fruit flesh from the shell were to let it rot off under the tree before collecting the nuts, letting it rot off collected nuts then wash them in water, gently hitting the flesh off with a stone or cutting the fresh fruit and removing the kernel. All respondents said they remove the kernel from the shell manually. Most of them use stones to break the shell while some used bush knives. The main problems encountered when removing the kernel from the shell was injuries to the operators hands. It was also very time consuming and some nuts were hard to crack and some kernels get damaged. Although the survey found all gender groups involved in extracting the kernels, it was more likely for women to do so as they are the ones who market the kernels.

Over half of the respondents had Galip cultivars that were easier to crack ('soft-shell' types) and most said they preferred soft-shelled cultivars. The majority of farmers store Galip nuts for a year or more; kernels are stored dried nut in shell, drying is done in baskets over a fire place or spread out in the sun. Few farmers reported problems associated with storing nuts but some had fungal or insect problems. Food security, out-of-season use and cultural ceremonies were the main reason given for storing the nuts.

Nut quality

Qualities that the respondents thought were important in determining good Galip nuts were big kernels, good taste, easy to crack shells and oily kernels. There was either a preference for nuts with only one kernel or the respondents were not concerned with how many kernels there were in the nut.

Marketing

Galip is very important as a source of cash, with 86% of the farmers selling some Galip. Women were the main gender group involved with the marketing of Galip, they were also assisted by the girls. Galip was sold as kernel for the fresh nut market, or as nut in shell if it was to be stored, or occasionally as whole fruit. More was sold as nut in shell or whole fruit in the Duke of York and Pomio than the Gazelle. There was very little grading or quality selection of the nuts prior to selling them in the markets, only a few graded by kernel size, shape or colour. All nuts were sold to the general public; there was no wholesaling or involvement of middlemen. The nuts were sold in central and road side markets if available (only in the Gazelle) or village markets. The pricing of the Galip depended to some degree on the supply and demand and on what others were selling at the time. In general it was higher in the Gazelle (K2.00 for 10–50 kernels) and lower in Pomio (20–50 toea for up to 100 kernels).

Due to the difficulty in obtaining economic information from the farmers and the reliability of the information gathered it is difficult to estimate how much farmers make from Galip. Results indicate that farming families make a about K40.00 per year from selling Galip and in some cases can be much higher—estimated to be K375.00 in one case. The money obtained from selling Galip generally was used for normal household expenses. Most farmers said they currently sell all the Galip they market and that they could sell more Galip if they had it, despite this the lack of buyers and the market competition were mentioned as problems by some respondents.

Tree improvement

The main improvements farmers said they would like to see in Galip is a reduction in tree size followed by increased yield, increased nut size, reduced seasonality, improved regularity of fruiting, better tree shape and improved ease of cracking the shell. Virtually all the farmers interviewed said they would like to plant Galip clones if they were available. The farmers in general said they wanted to plant large numbers of trees with 39% of them wanting to plant 50 or more trees. The main reasons given for wanting to plant more Galip trees was for additional income and family consumption.

LWR/2001/050: Equitable groundwater management for the development of atolls and small islands

Overseas Collaborating Countries	Kiribati, Tonga
Commissioned Organisation	Australian National University, Centre for Resource and Environmental Studies, Australia
Project Leader	Professor Ian White Phone: 02 6125 0660, 02 6125 3033 Fax: 02 6125 0757 Email: ian.white@anu.edu.au
Project Web Site	http://cres.anu.edu.au/
Collaborating Institutions	South Pacific Applied Geosciences Commission, Fiji Tonga Water Board, Tonga Ministry of Works and Energy, Kiribati Ministry of Lands, Survey & Natural Resources, Tonga Ministry of Agriculture and Forestry, Tonga Ecowise Environmental Pty Ltd, Australia Department of Agriculture, Kiribati
Project Budget	\$221,788
Project Duration	01/07/2002 to 31/03/2006 (Project extended from 01/01/2005 to 31/03/2006)
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

In low coral atolls, groundwater exists as freshwater lenses floating over saline transition zones, grading into seawater. To lessen the risk of seawater intrusion, groundwater is pumped from long, horizontal, infiltration galleries. Population growth, limited land, human activities including agriculture and frequent droughts place groundwater under stress.

Kiribati and Tonga rely on agriculture for valuable export earnings and subsistence. Both countries have major water resource limitations. Surface water is constrained by limited land area, permeable soils and high evaporation rates. Groundwater is therefore of critical importance, especially during drought. However, groundwater is vulnerable to seawater intrusion and mixing as well as contamination from inputs of agriculture, and demand is increasing. There are also issues to do with land ownership and water-use regulation.

Project objectives were: to understand the impact of agriculture on groundwater resources and the impact of groundwater extraction on agriculture; to explore management options for mitigating droughts; and to combine these outcomes with information on hydrology and on the economics and social aspects of island communities to produce a system to lessen conflicts over water allocation and use.

Project outcomes

Tarawa atoll in Kiribati has two regions—the heavily populated, urbanised South Tarawa and sparsely populated rural North Tarawa. In the low islands studied in Tarawa, Bonriki and Buota in South Tarawa, currently used for groundwater extraction, and the undeveloped Abatao and Tabiteua in North Tarawa, the spatial extents of their groundwater lenses have now been measured. These measurements permitted water balance estimates, using the highly variable climate record, of their sustainable pumping yields of fresh groundwater and identified potential sites for additional galleries.

A critical concern in small island communities with land overlying fresh groundwater stores is the impact of groundwater pumping for reticulated water supplies on traditional crops such as swamp taro and coconuts. On Bonriki, the community attributes a general decline in productivity of coconuts to groundwater pumping. An extensive study of shallow groundwater drawdown and salinity by pumping from all infiltration galleries on Bonriki and Buota found the mean drawdown due to pumping was close to the theoretically predicted drawdown. This was an order of magnitude less than diurnal tidal fluctuations of groundwater that coconut tree roots are exposed to. Pumping also had a negligible influence on groundwater salinity.

A theoretical study of the width of the saline transition zone beneath the freshwater lens estimated pumping increased its width by 37 per cent but the frequent El Niño droughts increase the transition zone width by 90 per cent. Examination of the sparse coconut trees at Bonriki and a review of their physiology indicated that declines in productivity were due to tree senescence and lack of crop management.

Because of the scarcity of land on small islands, agricultural activities, such as market gardens and swamp taro production, often encroach over shallow groundwater reserves. The use of animal manures and inorganic fertilisers, construction of open wells for watering and increased cropping density of coconut trees have raised concerns over impacts on groundwater. Extensive sampling of groundwater on Bonriki revealed *E. coli* bacteria and elevated nitrate and dissolved organic carbon levels in areas with market gardens and abandoned swamp taro pits. Large concentrations of hydrogen sulfide were also found due to reduction of sulfate in groundwater.

A water balance model was used to examine impacts of coconut tree density on groundwater recharge. Tree density had little influence during major wet periods. During droughts, however, it has a major impact causing significant periods of net groundwater loss. Predictions are consistent with measured groundwater salinity records. Analyses of the drought impact on the thickness and salinity of the freshwater lens predicted watertable falls of up to 400 mm during prolonged droughts, close to the measured decrease of 440 mm. Predicted increases in salinity of the freshwater lens are consistent with observed increases and measured saltwater intrusion. The nonparametric method of identifying droughts can provide a lead time of about three months warning of droughts.

Local and expert knowledge on groundwater and water supply has been collected and this has been incorporated with the hydrology and salinity dynamics into a Multi-Agent System for groundwater use and management, AtollScape. The system includes all the principal factors in water extraction and use, down to households. A role-playing game, AtollGame to explore different scenarios through use of AtollScape and reduce conflicts has been developed. A two-day trial of the game with relevant representatives from the islands of Abatao and Tabiteua and key government stakeholders produced a flow chart of financial, technical and social solutions and a proposal for a sequential refining of the process to arrive at equitable management options.

Modelling and monitoring of the major fresh groundwater resources demonstrated that a 30 per cent increase in sustainable freshwater extraction was possible for the capital, South Tarawa. In a country with less than 30 L/capita/day of reticulated freshwater this is a significant increase. But analyses of demand and the impact of frequent severe El Niño-related droughts has demonstrated that additional groundwater sources will have to be found for South Tarawa by 2010. The government has decided to initiate investigations for these additional sources.

FIS/1999/025: Optimal release strategies for restocking and stock enhancement of the tropical sea cucumber, sandfish (*Holothuria scabra*)

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	WorldFish Center, New Caledonia
Project Leader	Dr Warwick Nash Phone: 687 262000 Fax: 687 263818 Email: w.nash@cgiar.org
Collaborating Institutions	Australian Institute of Marine Science, Australia Ministry of Agriculture and Fisheries, Solomon Islands
Project Budget	\$1,171,638
Project Duration	01/04/2000 to 30/06/2006 (Project extended from 01/04/2004 to 30/06/2006)
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Sea cucumbers, processed into 'beche-de-mer', are a valuable source of income for many coastal communities in the Pacific Islands and the developing nations of South and Southeast Asia. The sea cucumbers are easy to harvest, process and store. Wholesale prices for first grade beche-de-mer of around US\$50 per kg have resulted in severe over-fishing in many tropical developing countries. It is now apparent that depleted stocks of sea cucumbers can take decades to recover. The release of juvenile sea cucumbers produced in hatcheries is seen as the most expeditious way to rebuild stocks. Eventually, the release of cultured juvenile sea cucumbers also has the potential to increase production beyond historical levels.

ACIAR has funded research at the WorldFish Center in the Solomon Islands to progressively develop, assess and transfer the technology for propagating and releasing tropical sea cucumbers. During the first stage of the project it was established that sandfish (*Holothuria scabra*) is the species most suited to restocking. They can be reared *en masse* in hatcheries on micro-algal diets, and juveniles can be grown in simple, land-based nursery systems with minimal input of food.

This project is the second stage of the partnership, which aims to identify the strategies for optimising survival of released juveniles, by developing cost-effective methods to ensure that a large proportion of cultured, juvenile sandfish released into the wild survive to adulthood.

Project outcomes

The project follows from the previous ACIAR-funded research conducted by the WorldFish Center (then ICLARM) in Solomon Islands, which developed methods for culturing the valuable sea cucumber, 'sandfish' (*Holothuria scabra*). Following conflict in Solomon Islands the project relocated to New Caledonia, partnered by the Secretariat of the Pacific Community (SPC). Higher costs to operate the project were met through substantial funding from the three Provinces of New Caledonia, the French Government and the ATSE Crawford Fund. Additional support was gained from internships of students from two French universities, INTECHMER and CREUFOP.

After constructing a simple 'field' hatchery (10 x 15 m) at the Saint-Vincent Aquaculture Station, tens of thousands of juvenile sandfish were produced from 2003 to 2005. Following the pioneering work by WorldFish Center in Vietnam, experiments were conducted to improve methods for growing sandfish juveniles in mesh enclosures in earthen ponds rather than in tanks. The approach occurs in two steps: firstly in 'hapas' (670 m mesh), then in 'bag-nets' (1 mm Tentex mesh). From a length of at least 5 mm, sandfish can be transferred from the hatchery to hapas in ponds. No feeding is required in hapas but growth rates were higher when units of 'fake seagrass', made from shade cloth, were included—a method that will speed up the time taken to grow juveniles to larger sizes for release in the wild. At 0.5 g in weight juveniles are transferred, at lower density, to bag-nets.

Feeding and added sediments were not necessary in ponds with high natural productivity; otherwise, feeding with ground shrimp pellets was best. Reasonable survival in bag nets placed in the sea within sheltered bays suggested that opportunities exist for rearing sandfish at hatcheries without earthen ponds. But poor growth implied that research would be needed for managing bag nets at sea.

A study with IFREMER scientists showed that sandfish and blue shrimp (*Litopenaeus stylirostrus*) could be co-cultured as juveniles. However, further experiments quashed the promise of commercial co-culture since larger shrimp at commercial densities killed sandfish juveniles. Sandfish can grow well in ponds directly on the sediment, but are difficult to collect for release into the wild. Land-based grow-out is possible—estimated growth of juveniles of 1 g to market size of 500–1000 g in 1.5 years—but economic feasibility will depend on the costs for ponds, labour and seawater pumpage.

WorldFish collaborated with scientists at the Australian Institute of Marine Science to determine the genetic structure of sandfish stocks through allozyme electrophoresis analyses. Restricted gene flow of sandfish meta-populations directed a responsible approach of translocating hatchery-produced juveniles close to the natal sites of the broodstock. A further study, incorporating mtDNA sequencing, resolved the species distinction of a putative subspecies, the 'golden sandfish' *Holothuria scabra* var. *versicolor*, and showed that it can hybridise naturally with sandfish.

Sandfish juveniles are hardy for transport at high densities for up to 24 hours. Hatchery-based simulations affirmed that this is best done at cool (26°C), stable, temperature in buffered seawater. Collaboration with a Belgian scientist led to a published protocol for examining sea cucumbers for disease and health prior to release.

In a significant breakthrough, two fluorochrome markers, tetracycline and calcein, were effective in 'tagging' sandfish juveniles for at least 1 year. Experiments then pinpointed the optimal immersion conditions to fluorescently mark dermal spicules of juveniles. The marking is cheap and only 2–5 mm of outer body wall of an animal is needed for mark verification with an epifluorescence microscope. Marked sandfish released into the wild can now be distinguished from wild counterparts.

Small-scale field experiments, of 1–5 weeks duration using 1-m² sea pens, examined optimal release conditions. Several key habitat characteristics were identified for maximising the survival of released juveniles: water depth of 0.5–2.5 m, moderately high seagrass cover, and moderate penetrability of sediments. Restocking programs can be flexible about the release time, since post-release survival differed little among groups released at sunrise, mid-day or sunset. Size does matter; juveniles smaller than 1 g were at risk of complete mortality. Acclimation of juveniles in mesh enclosures showed promise to overcome the initial shock of transport and release into the sea.

Two large-scale experiments were then conducted, in which marked juveniles were released into 500-m² sea pens. In the first, around 20% of the initial 2000 juveniles released at one site survived after 12 months and most reached the size of first sexual maturity. However, growth at the second site was slower and most animals died after 6 months. The second experiment used 9000 juveniles, 12 sea pens among four sites, and tested the effects of release density and juvenile size. Again, survival varied widely among sites, pointing that stock restoration programs should employ multiple sites.

The experiments give encouraging expectations of survival up to 25% after 12 months. Sandfish juveniles should be released into No-Take Zones (NTZs) to preserve them as nucleus breeding populations for restocking fisheries. An Individual-Based Movement model, incorporating field data on sandfish movement and growth, showed that NTZs would need to be 19–40 ha to protect the released animals over a 10 year period.

WorldFish conducted broad-scale underwater surveys of sea cucumbers as a commitment to the Provincial governments. Sandfish populations in the Northern and Southern Provinces appeared heavily exploited, with few sites having plentiful breeding populations. In the Loyalty Islands Province, stocks of commercially-important reef-dwelling species were spatially variable but high densities of black teatfish (*Holothuria whitmaei*) still exist. WorldFish provided management advice to the fishery departments and plans to assess reef-dwelling sea cucumbers in the Northern and Southern Provinces in a forthcoming project.

Projects under development

at 30 June 2006

Bilateral

FIS/2004/066	Feed development in the Pacific Islands
FIS/2005/108	Freshwater prawn aquaculture in the Pacific: Improving culture stock quality and nutrition in Fiji
FIS/2006/172	Pearl production from the winged pearl oyster <i>Pteria penguin</i> in Tonga
FST/2004/054	Improving value and marketability of coconut wood
FST/2005/089	Improved silvicultural management of <i>Endospermum medullosum</i> (whitewood) for enhanced community forestry outcomes in Vanuatu
FST/2006/048	Improved processing, storage and packaging of <i>Canarium</i> nuts
FST/2006/118	Sandalwood Inventory
HORT/2006/053	Evaluation of the effects of dasheen mosaic virus on taro yield
HORT/2006/055	Developing the ornamentals industry in the Pacific: an opportunity for income generation
HORT/2006/106	Screening and field trials of high-carotenoid sweet potatoes for improving the vitamin A status of residents of Solomon Islands and Papua New Guinea
HORT/2006/108	Smallholder fruit production in Tonga
HORT/2006/173	Fruits Tonga (projects)
LPS/2006/149	Feed for poultry and pigs in Tonga
PLIA/2006/021	Possible policy constraints to policy research in the Pacific
SFS/2004/030	Control of Asian honeybees in Solomon Islands
SFS/2005/171	Solomon Island project

Multilateral

HORT/2005/077	Integrated crop management package for sustainable smallholder gardens in Solomon Islands
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ACIAR publications

This list is a selection of titles from ACIAR's range of scientific publications that are relevant to the agricultural research and development sector of the Pacific island countries. Hard copies are available by emailing comms@aciar.gov.au. Publications may also be downloaded from ACIAR's website, www.aciar.gov.au.

Impact Assessment Series

- 19 Measuring the poverty impact of ACIAR projects: a broad framework
- 20 Mama Lus Frut scheme: an assessment of poverty reduction
- 21 Improving methods in diagnosis, epidemiology and information management of foot and mouth disease in SE Asia
- 22 Saving a staple crop: impact of biological control of the banana skipper on poverty reduction in Papua New Guinea
- 29 Impact assessment of research on the biology and management of coconut crabs on Vanuatu
- 34 Identifying the sex pheromone of the sugarcane borer moth
- 35 Review of the returns to ACIAR's bilateral R&D investments
- 37 Management of fruit flies in the Pacific
- 39 Benefits to Australia from ACIAR-funded research

Monographs

- 06 Chemistry of tropical root crops: significance for nutrition and agriculture in the Pacific
- 09 Giant clams in Asia and the Pacific
- 12 Biological control – Pacific prospects: Supplement 1
- 14 The giant clam: an anatomical and histological atlas
- 15 The giant clam: a hatchery manual
- 16 The giant clam: an ocean culture manual
- 18 Giant clams in the sustainable development of the South Pacific
- 20 Biological control – Pacific prospects: Supplement 2
- 27 Recollections of a Pacific entomologist
- 28 The economics of Papua New Guinea tuna fisheries
- 29 Stock assessment of coconut crabs
- 33 Illustrated guide to the identification of banana varieties in the South Pacific
- 35 A survey of the subsistence and artisanal fisheries in rural areas of Viti Levu, Fiji
- 38 Protected area assessment in Vanuatu: a socioeconomic approach
- 40 Essential oils of tropical *Asteromyrtus*, *Callistemon* and *Melaleuca* species
- 44 The major invertebrate pests and weeds of agriculture and plantation forestry in southern and western Pacific
- 45 Report on ACIAR-funded research on viroids and viruses of coconut palm and other tropical monocotyledons 1985–1993
- 48 Nutrient disorders of sweet potato
- 54 Survey Toolbox for Livestock Diseases: practical techniques for developing countries
- 55 A bibliography of food and other crops in Fiji
- 66 A review of Papua New Guinea's red meat industry
- 76 Plant genetic resources in the Pacific
- 80 Setting policy priorities for the development of tree crop industries in Papua New Guinea
- 81 Policy options for tree crop industries in Papua New Guinea
- 85 Fruits of Oceania
- 94 Survey Toolbox for Aquatic Animal Diseases: A Practical Manual and Software Package
- 100 Field methods for rodent studies in Asia and the Indo Pacific
- 101 The coconut odyssey: the bounteous possibilities of the tree of life
- 102 *Lantana*: current management status and future prospects
- 108 Pig husbandry in New Guinea: a literature review and bibliography
- 110 Advances in grouper aquaculture
- 119 Guidelines for surveillance for plant pests in Asia and the Pacific
- 120 Better-practice approaches for culture-based fisheries development in Asia
- 121 Planters and their components: types, attributes, functional requirements, classification and description

Proceedings

- 20 Management of wild and cultured sea bass/barramundi (*Lares calcarifer*)
- 21 Banana and plantation breeding strategies
- 24 Smallholder agricultural development in Tonga
- 28 Tropical tree seed research
- 30 Tuna baitfish in the Indo-Pacific region
- 47 The biology and mariculture of giant clams
- 52 Tuna baitfish in Fiji and the Solomon Islands
- 53 Coconut improvement in the South Pacific
- 66 Bluetongue diseases in the Asia-Pacific region
- 69 South Pacific indigenous nuts
- 76 Fruit flies in the Pacific
- 78 Mud crabs
- 79 Trochus: status, hatchery practice and nutrition
- 99 Food security for Papua New Guinea
- 102 Biological and integrated control of water hyacinth
- 119 Agriproduct supply-chain management in developing countries
- 120 Spiny lobster ecology and exploitation in the South China sea region

Technical Reports

- 02 Pastures in Vanuatu
- 04 Coconut germplasm in the South Pacific Islands
- 05 South Pacific agriculture — challenges & opportunities for ACIAR & its research partners
- 11 Economic prospects for vanilla in the South Pacific
- 14 Transport of vegetables in Papua New Guinea
- 15 Marketing perspectives on a potential Pacific spice industry
- 18 Post-flask management of tissue-cultured bananas
- 19 Utilisation of remote sensing in the South Pacific
- 23 Allozyme electrophoretic methods for analysing genetic variation in giant clams
- 24 Tuna baitfish and the pole-and-line industry in Kiribati
- 36 A guide to the zygotic embryo culture of coconut palms
- 44 A variety collection of edible nut trees in Solomon Islands
- 46 Kava (*Piper methysticum*) in the South Pacific
- 55 *Chromolaena* in the Asia-Pacific region
- 58 Evaluation of international provenance trials of *Casuarina equisetifolia*
- 59 Using seasonal climate forecasting in agriculture: a participatory decision-making approach
- 62 Pest and disease incursions: risks, threats and management in Papua New Guinea

Working Papers

- 6 Project development assessment: Pacific Island pearl oyster resources development (project 9131)
- 9 An economic evaluation of postharvest tropical fruit research: some preliminary results
- 12 Collaboration between ACIAR and other research institutions in research evaluation: experience in the Asia, Pacific and African regions
- 44 Defining practical guidelines for evaluating long-term, smallholder decision-making in developing countries
- 45 Collect, access and use of agricultural statistics in the Pacific Islands
- 53 Priorities for Pig Research in Southeast Asia and the Pacific to 2010
- 56 Agricultural Research and Poverty Alleviation: Some International Perspectives
- 60 Economics and marketing of the live reef fish trade in Asia-Pacific
- 61 The seaweed industry in the Pacific Islands